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EXPORT TRADE.

There seems no reason to doubt the fact that American manufactured goods continue to enjoy the appreciation of foreign purchasers in as marked a degree as ever, although the increase of the home demand has checked the possibilities in the export field. Many a manufacturer has to consider gravely whether he shall develop his productive capacity up to the full limit of the business offering him, and the dictates of prudence often is that he should go a bit slow in putting his profits into fixed plant. One thing is certain, that a connection once made for export trade it is well to maintain it, and even to develop it, we think, at the risk of not filling every domestic order as well. Creating and meeting export demand is not the easiest thing, and there are many pushing for it from other countries, where the home consumption is not so brisk. Aside from its immediate benefit, export trade has also the advantage of affording the manufacturer an outlet when his home trade is dull.

Turning to the figures for July, we are glad to find that the total exportation of manufactures for the seven months reach $245,756,052, as against $236,093,429 in the same period last year. When we remember the decline in metal exports, due to the urgent demand for them at home, this total is very satisfactory, especially as it is now to be reinforced by the figures of the large crops with which America helps to feed the world.

RULES FOR RESUSCITATION.

Some years ago we first issued our rules for the resuscitation of persons suffering from accidental electric shocks. It has been a matter of profound gratification to us to know that the use of these rules has proved efficacious in a number of instances; while the many applications for copies, of which we are continually in receipt, evidences not alone an appreciation of their value, but the great extension in recent years of circuits and apparatus of high, killing potential. In the present issue, which as an export number enjoys a special circulation throughout all parts of the world where such apparatus is in use, we present our readers with the latest revision of these rules and suggestions, brought up to date by Dr. Goelet in the light of the best information, data and theory applying to electro-physiology and electrotherapeutics. In many instances we have found our readers place these rules on the walls of central stations, isolated plants and power houses, etc., and knowing this, we have now printed it on stout, heavy paper, whose color being distinctive and familiar will help in quick reference to the rules in the hour of emergency. Extra copies will be furnished gratis upon application.

CENTRAL STATION RATES.

The discussion on central-station rates at the Cincinnati Electric Light Convention served to bring out not only the live interest which that subject has at the present time for central-station managers, but also the great divergence of opinion existing as to what constitutes a rational system equitable both to the central station and to the consumer. To those who have followed the subject closely, it has been quite apparent that the present time marks a transition period in the matter of central-station rates somewhat similar to that in the early history of the art when the abomination of flat rates was dispossessed. The situation is undoubtedly largely due to the more systematic manner in which central stations are now being conducted—in other words, to the fact that the electric lighting industry is ridding itself of the crudities of the develop-

ment period and settling down to the status of a business in which no detail is so slight as to be inconsequential. The discussion at Cincinnati and the symposium on rates which we print elsewhere in this issue would, however, appear to indicate, by the differences in opinion, that the problem of rationalizing central-station charges is not a simple one, and it may be of interest to inquire into the cause.

The problem involves three distinct elements, namely, the accurate determination of the cost of supply, including every item of expense; the elaboration on the data thus obtained of a general system of rates equitable to both sides; and the acceptance of such a system by the public. Considering current delivered to the customer as a commodity, the determination of the cost of this commodity is surrounded with considerable more difficulty than in the case of the usual manufactured article. This, however, should prove no particular obstacle to the active central-station manager, particularly in view of the enlightenment which he may receive by referring to the very considerable literature on the subject which has appeared. Such an analysis cannot be itemized too minutely in the first instance, for subsequently when the greater problem of a rate system is attacked, every possible means of guidance will be desirable. Or should the manager be satisfied to confine himself to a selection of one of the several rate systems now on trial, their relative desirability for his particular case can be tested by applying to them the results of his analysis.

From the fact that radical differences of opinion as to what constitutes a rational and practicable rate system prevail among central-station men who presumably have accurately and in minute detail determined costs, it is apparent that a difficulty of no mean order is encountered when it comes to elaborating a system of charging based upon such costs. This difficulty is almost entirely incident to the apportionment among individual consumers of the items not directly proportional to the cost of production of current, such as fixed charges, plant investment, etc. For example, we doubt if any rule can ever be laid down as to the exact relative charge there should be for current to the user whose demand is at the peak of the load, and to the one whose service entails little else than the actual cost of the corresponding fuel, as in the case of service only during the hours of light load. But the general principle cannot be contested that each consumer should, as far as possible, pay an amount for his service commensurate with the total cost of the same. In approach to this principle the flat-meter rate is merely an improvement on the old flat rate, and the addition of a system of general discounts merely mitigates the evil. A rate determined, whether by the capacity of the installation, total or partial, or by the maximum demand for current, or by a similar method which differentiates users into classes, is a still further advance, even if it does not meet the approval of those seeking perfection. What should constitute such a system is the matter now uppermost in the minds of progressive central-station men.

Assuming that an exact analysis of the case has been made, and a system based thereon which is entirely equitable from the business standpoint both to the central station and to the consumer, the major difficulty still remains, and that is to secure the approval of the public for the proposed tariff. As a public utility corporation enjoying a franchise which "burdens" the public domain, the business status of a central station with respect to the public differs totally, it is, perhaps needless to say, from that of the ordinary manufacturer, and this must be taken into consideration in any action affecting the public. A new system of rates is apt to be scrutinized by a consumer not as such, but as a citizen who feels that he is one of a body toward which the electric light company cannot afford to adopt an antagonistic attitude. If the rate is considered to be unsatisfactory, complaint will be made, not as an individual, but in the name of the public in general. Moreover, the custom generally obtaining in water and gas supply of not radically differentiating between customers, if at all, tends to cause differential rates for electricity to be regarded with suspicion. In view of the foregoing, it is quite evident that the central-station manager who would adopt a rational system of charging is beset by difficulties of no mean order. This situation undoubtedly accounts for the wide divergence of opinion to which we have referred, and for the considerable discussion of the past several years on a matter, which, if presented as a problem in an ordinary branch of business, would perhaps long before this time have found a perfectly satisfactory solution.

UNWISE CONSERVATISM.

It is most regrettable that at the recent naval manœuvres the regular use of wireless telegraphy was not included, and the implied rebuke to the naval bureaucrats in Admiral Higginson's urgent recommendation to the Navy Department on this subject was well deserved. Doubtless wireless telegraphy has its limitations, and doubtless it is not developed to the point it will have reached five or six years hence; but the fact remains that if the attacking squadron had been a real enemy it would have had the advantage of wireless communication which the defenders lacked. And as a matter of fact, such aid is of more importance to the defense than to the attack, for the former is spread out over a long stretch of coast with which it must keep in touch to facilitate the work of the land forces. No real attacking fleet would lack the services of fast scouts quite capable of coping with the scouts of the defense and crippling them, perchance long before they could communicate with the main body of their fleet. A descent upon the coast for the capture of a base is not likely to be made in broad daylight, but in the gloom of night when a foe cannot be picked up even with the help of searchlights until within easy range. With the wireless telegraph a scout could give the alarm even if she were a riddled wreck ten minutes later, and so would have played her part. As maaters now stand, we would be at a great disadvantage in this respect if attacked by any respectable power. Are we so soon to forget the lessons of 1898 in the danger of unpreparedness? To be sure, we have made advances since then, but they are the advances which should have been already made prior to that date. With the growing commercial jealousy on the part of many foreign powers and increase of jingoism at home, war is a far more likely contingency than it was half a dozen years ago, and when it next comes it will not be with a brave but outworn foe like Spain.

It is high time that the navy were equipped with a wireless telegraph system, and although tardy steps are now being taken in that direction, we are far from being equipped. Had the government purchased from time to time a trial installation of every seemingly practical system of wireless telegraphy put forth during the past six years, the cost would probably be much less than the aggregate expense of the numerous investigations of the Navy Department into the general question of wireless telegraphy. It is, moreover, a long step from bringing three or four competitive systems before a board of examination to the installation of the apparatus where it will be ready in time of need. If we remember correctly, it is nearly a decade since boards were appointed to look into the smokeless powders already in use abroad, but 1898 still found us unready except for some of the smaller guns and a few of medium calibre purchased abroad at the eleventh hour. And not only should we have the wireless system at once, but it is high time that we were hard at work on the matter of breaking down the communications of the enemy. We hear great argument about syntonic methods with loud asseverations that they can or cannot successfully be used. It is time to find out the facts in the case, for there may be a day in

which we shall sadly need to know. The enemy has been working industriously on wireless telegraphy and with a very gratifying degree of success; but it seems to be pretty well established fact that the sea is the best field for the work, and those who fight on the sea should be the first to be prepared. It is a wise policy doubtless to keep a cool head and to be slow in flying after every alleged improvement that may be presented, but wireless telegraphy, while it is still imperfect, is no scheme of a long-haired inventor, but is sufficiently useful and practical to have been already adopted by the navies of the great powers—barring the United States. It is high time to be up and doing and to keep up with the art of war instead of lagging behind.

RATIONAL ELECTROMAGNETIC UNITS.

We reprint on page 368 a translation of an interesting paper by Signor Giovanni Giorgi, of Rome, on a plan for the rationalization of electromagnetic units. The existing practical system of electromagnetic units embracing the volt, ampere, ohm, etc., is quite satisfactory from an industrial standpoint. It is likewise in international use, and formally adopted by law in most civilized countries. It is a scientific system connected with the decimal metric system, and far superior to any of the barbarous tables of weights and measures still employed in English-speaking countries. Nevertheless, the existing electromagnetic system is defective, even gravely defective, from a strictly scientific standpoint, and if we could expunge it and recreate a system of electromagnetic units without any precedents or history to consider, a much better system could be, and probably would be, adopted. The existing system contains three defects.

Firstly it is virtually based upon the earth's quadrant (10^9 cms.) as unit of length, the one-hundred-thousand-millionth of a gramme (10^{11} gramme) as unit of mass, and the second as unit of time; whereas it ought to be the simple and fundamental centimeter-gramme-second system. Consequently electromagnetics are necessarily taught theoretically in the C. G. S. system, and necessarily applied practically in the Q. E. S. system, which is almost as bad and ridiculous as the Chinese systems of speech and writing, where the written language is not spoken nor the spoken language written. The reason for the now seemingly ridiculous transition from the fundamental C. G. S. to the applied Q. E. S. system was that some of the unit magnitudes in the former were inconvenient. Thus, the C. G. S. unit of e. m. f. is very small from a practical standpoint, namely, about the hundred-millionth part of the e. m. f. of a gravity Daniell cell; so, instead of calling the little C. G. S. unit the volt, and employing a prefix, such as megavolt, to arrive at a practical magnitude for industrial purposes, a big decimal kinsman was selected for the volt to the neglect of the fundamental unit. The same was true of the ampere and ohm. The result is that while we have to use prefixes, anyhow, to meet practical requirements, such as in microhm, milliampere, megohm and microfarad, we have awkward decimal numerics separating all practical and theoretical units, an unnatural divorce that gives endless trouble to students, and for which, as we now look back, there was absolutely no use or necessity, no disparagement being offered to the labors of the great and worthy men who decided upon the existing system.

The second defect of the electromagnetic system of units is inherent not only in the practical Q. E. S. system, but also in its progenitor, the theoretical C. G. S. system. This is the defect which Mr. Giorgi mainly attacks. Owing to an unfortunate basis of definition, there is a continual recrudescence of the constant 4π occurring in ordinary unit relations, where it has no business to appear, and where it is a needless encumbrance; while in spherical problems, where the surface of a unit sphere (4π) should naturally appear, the constant is honored in the breach rather than in the observance. So that the C. G. S. system is in regard to 4π, like the cockney dialect in regard to *h's*. There is no *h* where it ought to be, and there is an *h* where it ought not to be. For example, the unit of m. m. f. ought to be equal to the current-turns in the C. G. S. system or to the ampere-turns in the Q. E. S. system; whereas it is 4π times the current-turns, or 4π times the ampere-turns in the two systems, respectively.

The third defect of the electromagnetic system of units also relates to the fundamental C. G. S. system, and that is that the system is not unique. There are two of them. One is the so-called electrostatic system, and the other the so-called electromagnetic system, so that when we speak of the C. G. S. unit of e. m. f., for example, it is not clear whether we mean the electric unit or the magnetic unit. The former has the magnitude of 300 volts, the latter $\frac{1}{100000000}$ volt. So that there is quite a difference, and the difference is different in the case of different units. In some the ratio is 3×10^{10}; in others it is 9×10^{20}. This ambiguity is unnatural, and is a consequence of definition. A strictly scientific system of electromagnetic would be unique. It would be essentially simple and single. It would not admit of duality.

It is evident on reflection that none of these three defects touches the practical man or the industrial user of electricity. A volt as defined by law would be serenely unaffected though the C. G. S. system were replaced by a much more nearly scientific system. The practical man is, therefore, content with the existing order of things, and not only desires no change, but vehemently protests that no change shall be made. Why upset contracts, literature and history, he argues, when we are all so comfortable? The argument is valid, and it is practically impossible to expect any change to be made in practical electromagnetic units in the near future, no matter what improvements theory may suggest. Nevertheless, the artificial difficulties which are raised in the science of electromagnetism by the above defects in the adopted systems of units retard knowledge and hinder progress, so that the defects do have some indirect bearing upon the practical side of the question.

Various attempts have been made to cover the 4π eruption by patching up the practical system. The suggestion of Professor Fessenden was one. The suggestion of Signor Giorgi, here considered, is another. These expunge the intruding 4πs in certain parts of the system by local barriers; so that in practical use the offending constant would seldom offend the purist's sight. But in more deep-seated equations the four pis would come trooping in. The only completely successful way of keeping them out of plane problems and confining them to spherical problems, where they belong, is to go back to the fundamental definitions of units and correct these, as Heaviside has done. This cures the evil, but there results new C. G. S. units of e. m. f. of current, and of everything else, all related to the existing C. G. S. units by awkward functions of 4π; so that the remedy is worse than the disease, unless we can change our practical Q. E. S. units, to match; which is at present a hopeless expectation. Moreover, if we were to "rationalize" the C. G. S. and Q. E. S. systems so as to stop the 4π eruption, there would yet remain the first and third defects above mentioned. Consequently, it seems better to go on in our evil ways and persist in our international Q. E. S. system, which is, after all, very good if it is not scientifically the best. In time, theory will doubtless indicate the best means of jointly eradicating the two defects in the C. G. S. system so as to make it unique, and at the same time to handcuff the vagrant 4πs. Then when a really scientific new C. G. S. system, or its improved representative is agreed upon, it can be imported into practice directly by the use of suitable prefixes and suitable new names, which will not conflict with the present names.

Programme for the Edison Association Meeting.

A very interesting and attractive programme has been prepared for the twenty-third convention (eighteenth annual meeting) of the Association of Edison Illuminating Companies which will be held at the Mount Washington (a hotel near Mt. Pleasant House station, N. H., on the Boston and Maine R. R.), commencing Tuesday, September 9, 1902, at 9:30 A. M. We give below a list of the papers prepared to be read: "Recent Developments in Distribution System in Boston," by Mr. Sidney Hosmer, Boston; "Aspects of Safety and Reliability in High Tension Transmission and Distribution of Current from Annex Stations in Large Cities," by Mr. Philip Torchio, New York; "Construction and Operation of Underground High Tension Transmission," by Mr. H. J. Gille, St. Paul, Minn., and Mr. H. G. Carlton, Chicago; "High Tension Work in the Far West," by Mr. George H. Lukes, Chicago; "Development of New Forms of Illumination and Their Possible Influence on Central Stations (Nernst Lamps, Hewitt Lamp and Welsbach Arc Lamp)," by Mr. George Eastman, Chicago; "The Effect of the Nernst Lamp Upon Methods of Illumination," by Mr. Murray C. Beebe, Chemist Nernst Lamp Co., Pittsburg; "The Distribution of Light from Incandescent Lamps as Affected by Shades Commonly in Use," by Mr. John W. Howell, Engineer Edison Lamp Works, Harrison, N. J.; "Original Researches in Electrical and Chemical Laboratory," by Mr. Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.; "The Order System and Its Influences Upon Cost," by Mr. Wm. M. Anthony, Chicago; "Campaigning for Business," by Mr. John F. Gilchrist, Chicago; "Advertising and Canvassing," by Mr. Arthur Williams, New York; "Commercial Conditions with Customers," by Mr. J. T. Maxwell, Philadelphia; "Some Problems in the Design, Development and Operation of Large Central Station Systems," by Mr. P. Junkersfeld, Chicago; "Utilization of Waste Energy of Central Stations," by Mr. W. H. Schott, Chicago; "Steam Pipe Covering and Its Relations to Station Economy," by Mr. Henry G. Stott, Supt. Motive Power, Manhattan Ry., New York; "Coal," by Mr. Robert Lindsey, Cleveland, and Mr. W. L. Abbott, Chicago; "Storage Batteries," by Mr. Gerhard Gottling, Boston; "Integrating Electric Meters and the Meter Department," by Mr. George Ross Green and Mr. P. H. Bartlett, Philadelphia; "Checking Electrical Instruments," by Dr. C. H. Sharp, Test Officer, Lamp Testing Bureau, New York; "Automatic Voltage Regulators," by Mr. W. S. Andrews, Schenectady; "The Use of Superheated Steam," by Mr. Charles H. Parker, Boston.

Besides these papers there are other subjects prepared for presentation, the reports of various committees and the usual open discussion of the many papers and subjects presented.

The convention this year may occupy four days, with a morning and a night session each day, the afternoons being devoted to recreation. One feature of the entertainment will be a golf contest on the links at the Mt. Washington, open for ladies and gentlemen. It is understood that the parent General Electric Company will extend various courtesies to members while the convention is in session.

Power Development at Niagara.

There is every prospect that the Niagara Falls Power Company will be delivering electric power from its second station about October 1. The output capacity of this second installation will be 55,000 hp, developed by 11 generators operated by a like number of turbines, each being of 5,000 hp capacity. The turbines are being placed in a new wheel-pit that is 178½ feet deep, 18½ feet wide and which has a length of 463 feet 8 inches. This wheel-pit is excavated out of solid rock, and to meet its requirements the tunnel was extended. The new power house covers the pit, having a total length of 560 feet. The power house is 70 feet wide, and on the west side there is a covered forebay structure that has a width of 40 feet. In this covered forebay structure the racks are placed, the water entering from the inlet canal though arches opened beneath the surface. The racks of the original power house are unprotected by a covering, and there is no forebay structure.

The National Contracting Company, of which Walter McCulloh is resident engineer at Niagara, completed its contract early in August. The completion of the contract of the National Contracting Company leaves the future work in charge of the Niagara Falls Power Company and the contractors on the power house and installation. The work of erecting the superstructure is in the hands of Mosier & Sumers, of Buffalo, and they have their contract well advanced. The building is nearly all roofed and slated, and attention is being given to the center gable and the storehouse structure at the rear end. From every point of view the new house is by far the superior of the old station, which has always been considered a very magnificent building. Beauty has been added at several points. The stone used in its construction is the same as used in the original building. The power house is fire proof in all parts.

The turbines to be installed in the new pit are the product of the I. P. Morris Company, of Philadelphia, which company now has a force of men at Niagara on the work. Wheels No. 11, 12 and 13 are in place, and the shaft of Wheel No. 11 has been set. In this new station the wheels and generators will be numbered from No. 11 to 21 inclusive, as the machines in the old station are numbered from 1 to 10, inclusive. Thus the total equipment of the two great stations will be 21 turbines and the same number of generators, the total output capacity of which will be 105,000 hp. The new turbines are of the internal discharge type, the water being carried off through draft tubes, giving an increase of about 10 per cent. to the effective head. The turbines were designed by Escher, Wyss & Co., of Zurich, Switzerland.

The generators for the new station are, as already noted, being manufactured by the General Electric Company, and the work of erecting the first one is now in progress. There will be two styles of generators in the new station, the first six to be very similar in design to those now in operation in station No. 1, with the exception that the bridge over the machines will be dispensed with. These six machines will be of the external revolving field type, while the other five will be of the internal revolving field type. The interior of the new power house, as well as the outside vicinity, presents a remarkable scene of activity, and many men are constantly on the jump in order that there may be no unnecessary delay in obtaining power at the earliest possible date. In the inlet canal a dredge, scow and tug are at work taking out the cofferdam erected to aid the forebay construction, while out in the river in front of the inlet canal, the channel is being dredged in order that there may be a free flow of water to the inlet both in summer and winter. An addition is being built to the transformer station, and this is an intimation that some of the current generated in the new power house will be transmitted to a distance from the Falls. Mr. William A. Brackenridge is the resident engineer of the Niagara Falls Power Company, and is giving careful supervision to the work.

United States Manufacturing Activity and Foreign Trade.

The increasing activity of the manufacturers of the United States is illustrated on both the export and import sides of the latest figures of the Treasury Bureau of Statistics. During the seven months ending with July, 1902, the exportation of manufacturers was nearly $10,000,000 greater than in the corresponding months of the preceding year, and the importation of manufacturers' materials was 30 millions greater than in the corresponding months of the preceding year. The exportation of manufactures during the seven months of the present year has averaged $35,108,000 per month, or at the rate of $421,000,000 per annum, while the importation of manufacturers' materials has averaged $36,000,000 per month, or at the rate of $432,000,000 per annum. Nearly all of the principal manufactured articles exported, except iron and steel, show an increase in quantity and in most cases in value, though in a few important articles the reduction in price per unit of quantity has brought the value below last year's figures, while the quantity shows an increase. Copper, in which there was a decided decrease in the exportations of last year owing to high prices, now shows a marked increase, the figures being $49,614,210 for the seven months ending with July, 1902, against $20,731,622 for the same months of 1901. The chief decrease in exports occurs in iron and steel, the total exports during the seven months of this year being $57,263,304, against $61,160,730 in the corresponding months of last year.

On the import side nearly all the principal classes of manufacturers' materials show an increase. Chemicals increased in imports from $32,591,372 in seven months of 1901 to $53,831,377 in the same months of 1902. India rubber shows a slight decrease in importations, the total having fallen from 34,899,446 pounds in seven months of 1901, to 30,308,134 pounds in the same months of 1902, though the figures of 1902 are considerably in excess of those for the corresponding months of 1900.

Water Power Transmission for the Springfield, Mass., Lighting System.

THE Birchem Bend station recently put into operation by the United Electric Light Company, Springfield, Mass., completes a water-power equipment larger than that of any other electrical supply system in the State. In ELECTRICAL WORLD AND ENGINEER of Sept. 28, 1901, a full description of the Springfield system as it then existed was given, together with a record of its operation and the percentages of its output derived from water-power for a series of years. At the above date the water-power station at Birchem Bend was under construction and could not be fully described, but it has since been completed, together with some other additions to the system. The new stone dam, canal and power-house at Birchem Bend are designed to utilize the entire flow of the Chicapee River at a point where a fall of about 14 feet between the top of the dam and the level of tail water has been developed. These structures are located in the suburbs of Springfield, at a point about six miles from the steam-driven electric station on the bank of the Connecticut River, in the heart of the city. A short canal with sides of stone and bed of concrete conducts water from one end of the dam at Birchem Bend to the side of the power-house. By a somewhat novel construction, the turbine wheels are mounted in their cases directly on the floor of the canal in two sets. Each set has a single, horizontal shaft that passes through the side wall of the power-house in a watertight stuffing-box. The rating of each set of wheels is 600 hp, at 130 r. p. m. The power-house is a building of pleasing design with walls of brick save on the canal side where they are of heavy stone masonry to a distance of 5.1 feet above the top of the dam. At the floor level, the power-house is 52 feet 8 inches by 26 feet 6 inches, and 26 feet 9 inches from concrete floor to the bottom of the steel roof trusses. A hand-crane sweeps the entire interior of the power-house at a distance of 21 feet 6 inches above the floor.

On each of the two horizontal turbine shafts that enter the power-house through the heavy masonry wall which separates its interior from the water in the canal a generator of 400-kw capacity, together with an exciter, is mounted. These two generators are two-phase with revolving fields, 6,000-volt and 60-cycle, at 130 r. p. m., made by the Westinghouse Company. The frame of each generator extends below the floor in a pit formed for the purpose. A small pump is provided to keep these pits free of any water that may find its way through the wall that separates the interior of the power-house from the canal.

FIG. 1.—CANAL AND TAIL RACE.

Current passes from these two generators, at 6,000 volts, directly to the switchboard, where the output is recorded by wattmeters, and then to the steam and substation in the business center of Springfield. The transmission to the substation takes place over either one of

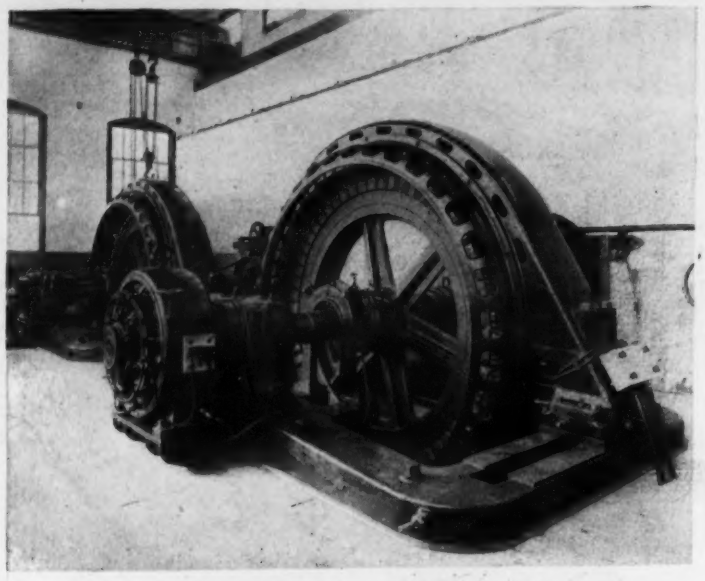


FIG. 2.—400-KW GENERATORS.

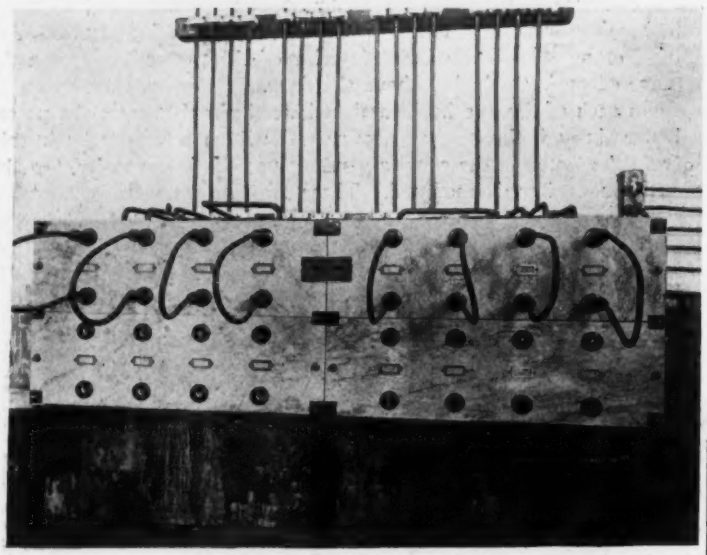


FIG. 3.—PLUG BOARD FOR CONNECTING TWO STATIONS.

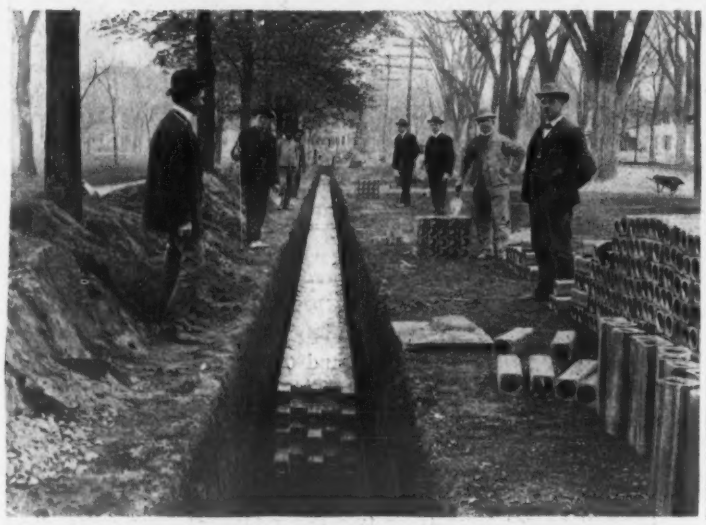


FIG. 4.—UNDERGROUND CONDUITS.

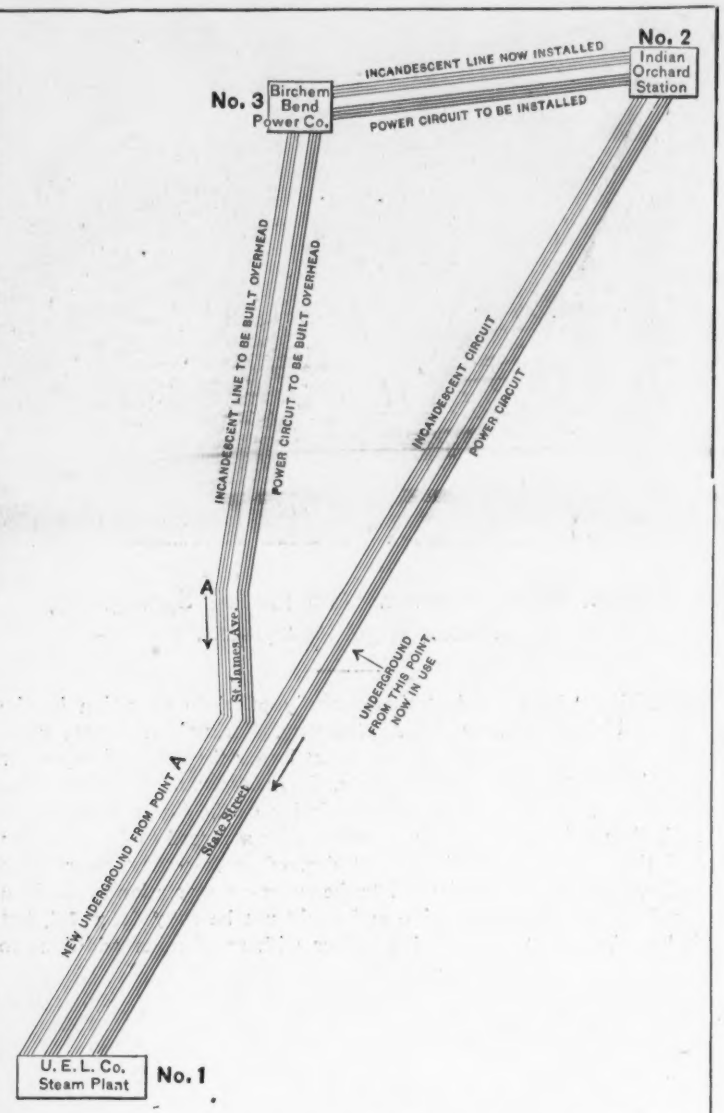


FIG. 5.—METHOD OF CONNECTING THE TWO WATER POWER STATIONS WITH THE STEAM PLANT.

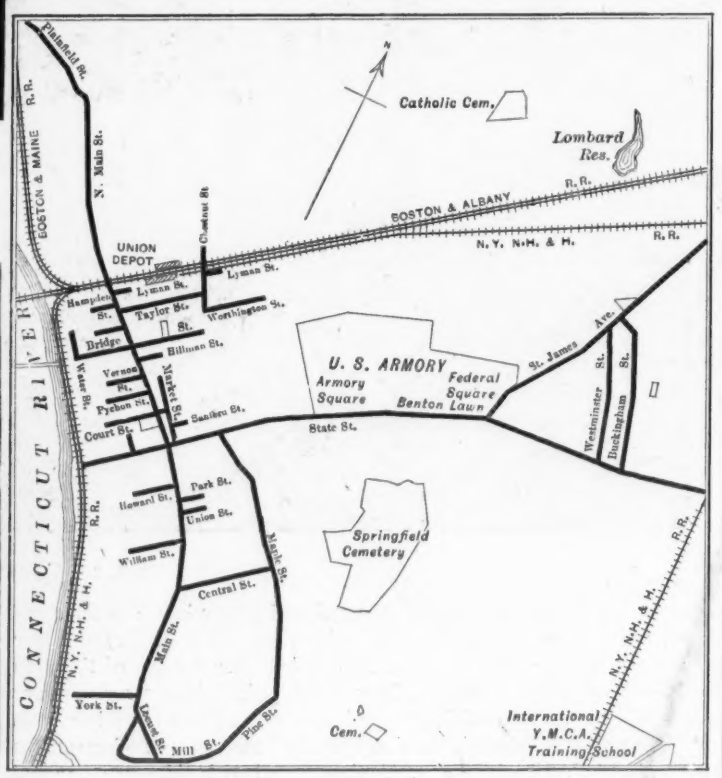


FIG. 6.—MAP SHOWING PRESENT UNDERGROUND SYSTEM.

SPRINGFIELD WATER-POWER TRANSMISSION SYSTEM.

two lines. One line passes from the Birchem Bend plant in nearly a direct line to the substation. The other line connects the Birchem Bend station with the water-power plant of the company, at Indian Orchard, about one and a half miles distant, on the same river. From the plant at Indian Orchard another transmission line goes to the substation, so that energy from either or both of the water-power plants may pass to the substation over either or both of the lines to the substation, as may be noted by the drawing. Each of these transmission lines is made up of eight conductors. Four of these conductors carry two-phase energy for general use, and terminate in a fireproof transformer room in the building that serves at once for a steam plant and a substation. Transformers in this room reduce the voltage from 6,000 to about 1,200 for general commercial lighting. The other four conductors of each transmission line connect with two alternating machines at the substation, each of which is rated at 350 kw, 5,500 volts and 60 cycles, two-phase. These two alternators were built by the Stanley Electric Manufacturing Company, and are of the induction type. By means of shaft and belt connections, these alternators at the substation are used to drive a 500-kw, 500-volt generator there, made by the General Electric Company, that supplies direct current for the load of stationary motors, when the water-power is ufficient to carry the entire load of the system. When there is not enough water-power to carry both the lighting and motor loads, the 500-kw, direct-current generator is driven by steam, as also one or both of the 350-kw alternators at the substation. The transmission line from the Birchem Bend station, and also the line from the Indian Orchard plant, are carried about four miles on poles. At a distance of about two miles from the substation, each lines passes

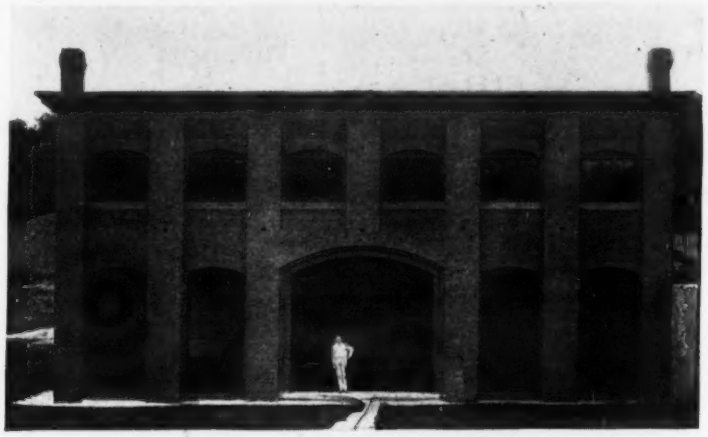


FIG. 7.—POWER HOUSE.

from poles to underground conduits of vitrified clay and so continues for the remainder of its length. In the conduits, the transmission lines are made up of duplex rubber and lead-covered cables, laid one cable per duct. Besides the alternating service to arc and incandescent lamps, and the circuits for direct-current motors from the substation, a line at 110 volts, direct-current, is connected there with a 300-ampere dynamo, and makes a little circuit around about the center of the city to operate several charging stations for the batteries of electric vehicles.

This line, like many of the other distribution circuits of the system, is entirely underground. During the past year the company has laid about 300,000 duct feet of vitrified clay conduit. All of the circuits in these conduits are composed of rubber and lead-covered cables. The accompanying map illustrates the extent of the underground circuits for electric light and power in Springfield. Running directly away from the river in the same general direction as the Boston and Albany Railroad are the transmission lines, which separate at a point distant between one and two miles from the substation. The other underground work forms a part of the distribution system. The total length of underground conduit now in use includes more than 600,000 duct feet.

At the brick building which serves as both a sub and steam-power station, important changes are going on. The building is two stories, and originally had timber floors. These floors have just been replaced with steel beams, brick and concrete, so as to turn the building into a thoroughly fireproof structure.

Capacities of transformers connected for service from the Springfield system, and the number of each are as follows:

Number	Lamps.	Number	Lamps.
23	10	11	80
36	12	3	90
110	20	33	100
1	25	28	150
64	30	18	200
55	40	10	300
32	50	6	400
3	60	2	500
7	75	1	600

The total number of these transformers is 443, with a combined capacity of 28,562 lamps. Of this capacity, that of 10,462 lamps is in transformers rated at less than 100 lamps each, and that of 18,100 lamps is in transformers rated at 100 or more lamps each. The numbers and capacities of consumers' meters in use on the system follow:

100-VOLT METERS.

Number	Amperes	Number	Amperes
11	3	112	50
284	5	9	75
296	10	29	100
291	15	9	150
153	25	3	200
1	30	6	300

50-VOLT METERS.

Number	Amperes	Number	Amperes
1	5	1	30
39	10	18	50
16	15	7	100
1	20	5	150
31	25	1	300

500-VOLT METERS.

Number	Amperes	Number	Amperes
5	3	1	75
10	10	2	100
25	15	1	150
19	25	1	300
6	50		

220-VOLT METERS.

Number	Amperes
1	50

1,000-VOLT METERS.

Number	Amperes	Number	Amperes
1	10	1	25
2	15	2	30

ARC METERS.

Number	Amperes
2	18

The number of public arc lamps supplied is 867, all of the enclosed type, at five amperes, operated by constant current dynamos located at the Indian Orchard station. Commercial enclosed arcs to the number of 522 are in use. The connected load of incandescent lamps amounts to 45,735 of 16-candle-power. Motors with a combined capacity of 1,025 hp, and numbering 264, are connected to the 500-volt, direct-current lines. At Indian Orchard the capacity of dynamos is about 2,000 kw, and the 800 kw at Birchem Bend brings the total for water-power stations up to 2,800 kw, an equipment much larger of its kind than that of any other electrical supply system in the State. The above improvements have been completed under the management of Mr. Walter L. Mulligan, to whom thanks for the interesting facts here presented are due.

Electrical Agriculture in Germany.

In a paper at a recent conference of German electrical engineers, Dr. Haas, of Hanover, referred to the electric power supplied to agriculture in that neighborhood. The greatest demand for current was for the operation of thrashing machinery, although energy was also used for driving pumps, hay presses, straw-cutters, etc. Of the total horse-power installed, 77 per cent. represented purely agricultural operations, and 8 per cent. factories, although the former only yielded 53 per cent. of the receipts. On an average, the annual revenue per horse-power installed amounted to $6.73 (as compared with from $17.03 to $36.50 in towns) at a price of 57 cents per kw-hour, and the average period of use did not reach 150 hours, as against 500 hours in towns. There is little demand for light in the villages, as the people retire early. The author concludes, from the experience in the Hanover district, that satisfactory results are possible in agricultural operations only where cables already exist for the transmission of power or for electric tramways, which can readily satisfy the small and occasional demand for agricultural purposes.

Tests of Steam Turbine Installed at Hartford, Conn.

By Prof. Wm. Lispenard Robb.

The reason for publishing the following summary of the tests made by me of the steam turbine installed by the Westinghouse Machine Company in the plant of the Hartford Electric Light Company, at Hartford, is the frequent requests that come to officers of the company for a copy of the results.

The tests were made primarily for the purpose of determining the efficiency that would be obtained under the actual operating conditions at Hartford. No attempt was made to maintain during the tests any unusual conditions. The station was operated by the

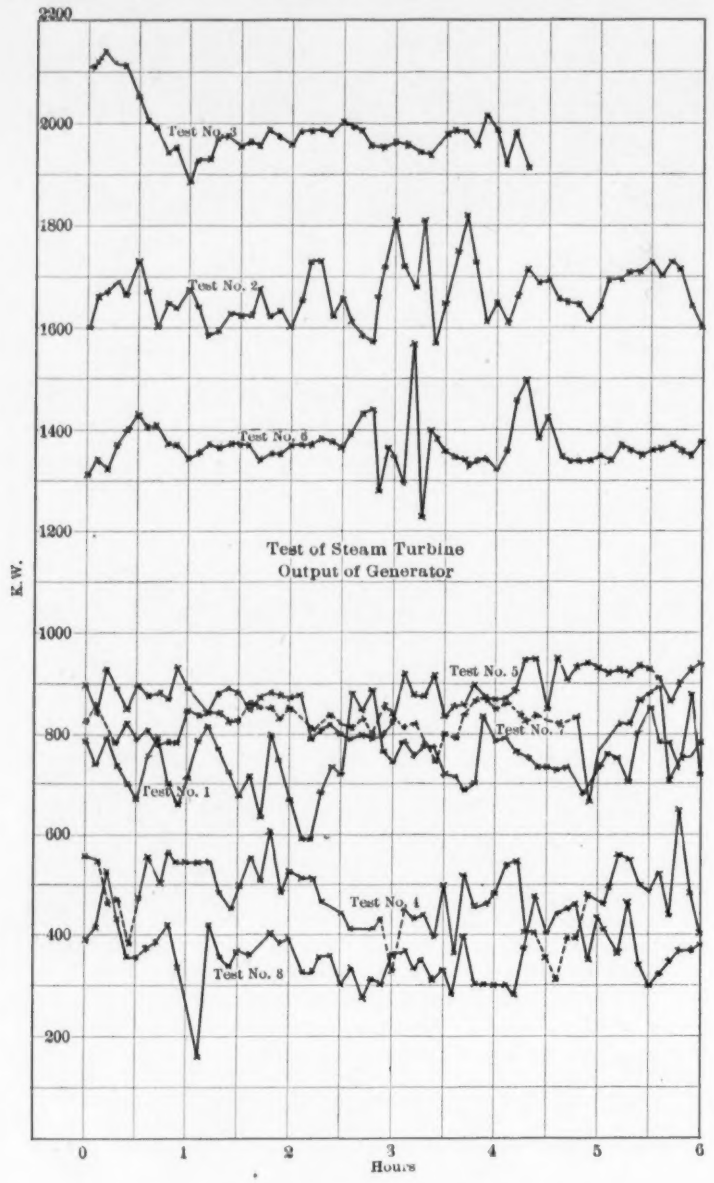


FIG. 1.—CURVES SHOWING VARIATION IN LOAD.

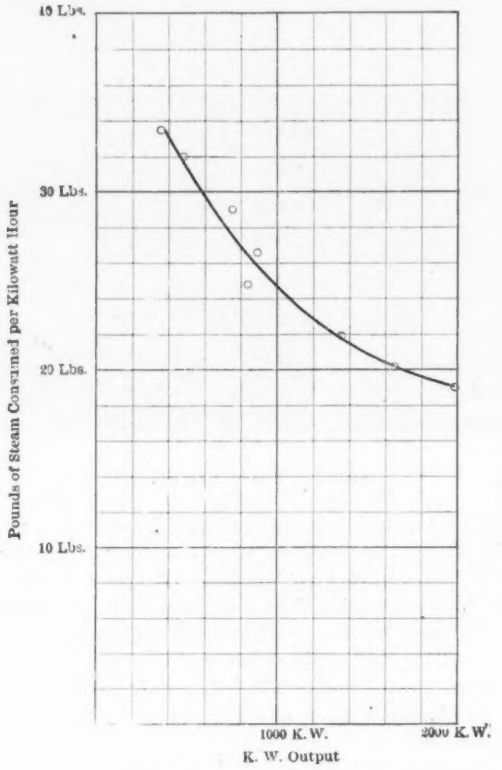


FIG. 2.—CURVES SHOWING STEAM CONSUMPTION PER KW-HOUR.

regular station force during the tests; the various readings and measurements were made by me with the assistance of several of the students in the Electrical Laboratory of Trinity College.

The tests were discontinued from February 1st to May 7th, to permit alterations in the construction of the shaft which previous tests had shown to be desirable.

The following brief description will show the conditions under which the turbine is ordinarily operated:

The chief power of the Hartford Electric Light Company is water power, steam being used simply to supplement this in case of low water. In a year of normal rainfall the steam plant would be operated practically continuously for about three months, and during the peak of the load for about as many more months.

The steam turbine was installed on account of its lower first cost; small cost of installation; relatively small space occupied in the station, and its relatively high efficiency at fractional loads. The turbo-generator installed at Hartford has a rated capacity of 1,500 kw. It has developed, however, that the capacity is considerably greater, and it would now be rated at 2,000 kw.

The boiler plant consists of three Aultman-Taylor water-tube boilers, each having a rated capacity of 550 hp. The condenser is of the barometer type, manufactured by the Worthington Company, and the water for condensing purposes is supplied from three cooling towers.

The output of the generator was measured by instruments carefully calibrated with standard Weston instruments. As the condenser was of the jet type, the steam consumption had to be measured by weighing the input of water into the boilers. In order to obtain accurate results this, of course, necessitated continuing the tests through a considerable time, so as to eliminate any error due to inaccuracy in having the same quantity of water in boilers at the beginning and end of tests.

During the test, one of the boilers was disconnected from the other two and used to operate the steam auxiliaries. The remaining two boilers were used for supplying steam to the turbine itself. One of the two latter boilers was equipped with a superheater, capable of superheating the steam from that boiler to about 60° F. As the steam from this boiler was mixed with the steam from the second boiler it insured superheated steam at the turbine. The degree of superheat, however, fluctuated very widely, depending on the relative amount of steam supplied from each of the two boilers. During the first test the boiler with superheater was cut out.

The accompanying table gives a summary of the readings and results obtained therefrom. The steam consumption represents the steam supplied to the turbine and does not include that used by the auxiliaries. An inspection of the table shows that, owing to the length of time required for the tests and the inability to vary the conditions without interfering with the station operation, all he tests, with the exception of the first one, were made under very closely similar conditions as regards vacuum and the amount of superheat in the steam. It would have been very interesting to have repeated these tests under varying conditions of superheat and vacuum, but as yet the opportunity has not offered, and it would in any case be very much more satisfactory to carry out a special series of tests in a plant equipped with a surface condenser.

The curves of Fig. 1 show the variation in load during the various tests.

I have embodied the results contained in the above table in the curve of Fig. 2, giving the steam consumption per kw-hour as a function of the load. In the case of the first test, where the steam was not superheated, I have reduced the results to what they would

have been had the degree of superheat been the same as the mean in the other tests, that is 32.9° of superheat. In making this correction I have made use of the data obtained by W. H. Lindley and Schroeter and Weber in their tests of the turbo-alternator for the Elberfeld Corporation. These tests are very fully given in a paper, "On the Trial of Steam Turbines for Driving Dynamos," by Hon.

TEST		LOAD			LENGTH OF TEST	STEAM GAUGE PRESSURE			BARO-METER	INCHES VACUUM AT TURBINE			SUPERHEAT DEGREES F.			COAL		STEAM	
No.	Date	Aver.	Max.	Min.		Mean.	Max.	Min.		Mean.	Max.	Min.	Mean.	Max.	Min.	E. H. P. Hour	K W. Hour	E. H. P. Hour	K W. Hour
	1902	K.W.	K.W.	K.W.	Hours	Lbs.	Lbs.	Lbs.	In.	In.	In.	In.	O	O	O	Lbs.	Lbs.	Lbs.	Lbs.
1	Jan. 27	748	885	580	6	155.5	161.0	143.0	30.70	26.22	27.30	25 50				2.27	3.02	24.13	32.17
2	" 28	1657	1820	1480	6	151.3	158.0	145.0	30.73	28.00	28.20	27.85	40.08°	61.34°	19.85°	1.33	1.76	15.15	20.2
3	Feb. 1	1998	2185	1900	4	155.4	158.0	146.0	30.27	26.91	27.30	26.75	41.56	55.05	32.45	1.28	1.70	14.43	19.10
4	May 7	471	730	310	6	151.8	155.0	147.0	29.86	26.62	26.90	26.20	19.10	29.00	3.50	2.20	2.93	23.97	31.96
5	" 8	888	980	750	6	152.6	156.0	149.0	30.04	25.83	26.70	25.50	32.90	47.50	12.00	1.85	2.46	19.90	26.53
6	" 9	1371	1570	1110	6	151.9	156.0	140.0	29.81	26.26	26.90	25.50	32.10	38.60	12.50	1.52	2.03	16.46	21.94
7	" 12	834	940	660	6	153.2	157.0	149.0	30.26	27.26	27.40	27.00	35.40	45.10	20.10	1.76	2.35	18.50	24.60
8	" 13	364	520	150	6	153.1	156.0	149.0	30.06	27.40	27.60	27.10	29.0	41.00	2.50	2.49	3.32	25.10	33.47

Charles A. Parsons, F. R. S., and published in London *Engineering* for September 6, 1901. These tests show a gain of efficiency of about 12 per cent with 55° C. superheat, and that every inch of vacuum improves the steam consumption about 4 per cent.

The World's Land and Sea Telegraphs.

"The Submarine and Land Telegraphs of the World" is the title of a monograph prepared by the Treasury Bureau of Statistics which will appear in the forthcoming Monthly Summary of Commerce and Finance. It presents some information regarding the submarine telegraphs of the world which is especially interesting at this time in view of the prospective construction of an all-American cable across the Pacific. It shows that the submarine telegraphs of the world number 1,750. Their aggregate length is nearly 200,000 miles; their total cost is estimated at $275,000,000, and the number of messages annually transmitted over them is more than 6,000,000. Adding to the submarine lines the land-telegraph systems by which they are connected and through which they bring interior points of the various continents into instantaneous communication, the total length of telegraph lines of the world is 1,180,000 miles, the length of their single wires or conductors 3,800,000 miles, and the total number of messages annually sent over them about 400,000,000, or an average of more than 1,000,000 each day.

Nearly a score of cables have been laid across the Atlantic, of which no less than thirteen now successfully operate between the United States and Europe, while three others span the comparatively short distance between South America and the African and South European coast lines. Throughout the Indian Ocean lines connect the Far East with Europe and America via the Red Sea, the Mediterranean, the western coast of Europe, and the great trans-Atlantic lines. The Mediterranean is crossed and recrossed in its entire length and breadth by numerous cable lines, and the "Mediterranean of America," the Gulf of Mexico and the Caribbean Sea, is traversed in all directions by lines which bring its islands and colonies into speaking relations with each other and with South America, Central America, the United States, and thence with Europe, Africa, Asia—the whole world. Along the eastern coast of Asia, cable lines loop from port to port, and island to island, receiving messages overland from Eastern Europe via the Russia-Siberian land lines and forwarding them to Japan, China, Australia, New Zealand, the Straits Settlements, Hongkong, and the Philippines, and receiving others in return. South America is skirted with cable lines along its entire border save the extreme south, where they are brought into intercommunication by land lines. Along the entire coast of Africa, cables loop from place to place and from colony to colony, stretching along the entire circumference and penetrating the interior by land lines at various points.

Every body of water lying between the inhabited portions of the earth, with the single exception of the Pacific Ocean, has been crossed and recrossed by submarine telegraph lines. Even that vast expanse of water has been invaded along its margin, submarine wires stretching along its western border from Siberia to Australia, while its eastern borders are skirted with lines which stretch along the western coasts of the two Americas. Several adventurous pioneers in Pacific telegraphy have ventured to considerable distances and depths in that great ocean, one cable line running from Australia to New Zealand, a distance of over 1,000 miles, and another extending from Australia to the French colony of New Caledonia, 800 miles seaward. A cable which is to connect Canada with Australia across the Pacific is now being laid at the joint expense of the United Kingdom, Canada and the Australian Commonwealth and has already been completed from Vancouver, British Columbia, to Fanning Island, just south of the Hawaiian Islands, and it is expected that the entire line will be completed by the end of the present year.

The chief obstacle to the construction of a grand trans-Pacific cable was found in the fact that mid-ocean resting places could not be satisfactorily obtained or arranged for, no single government controlling a sufficient number of suitable landing places to make this seem practicable, in view of the belief that the distance through which messages could be sent and cables controlled was limited. With landing places at Hawaii, Wake Island, Guam, and the Philippines, however, no section of a cable stretching from the United States to Asia and touching at these points would have a length equal to that now in daily operation between France and the United States. The length of the French cable from Brest, France, to Cape Cod, Mass., is 3,250 miles, while the greatest distance from land to land on the proposed Pacific route would be that from San Francisco to Hawaii, 2,089 miles; that from Hawaii to Wake Island being 2,040 miles, from Wake Island to Guam 1,290 miles, from Guam to Manila, 1,520 miles, and from Manila to the Asiatic coast 630 miles. While the depth of the Pacific is somewhat greater than that at which any cable has been laid, the difference between its depth and the greatest depth reached by cables in the Atlantic would be very slight, the cable recently laid from Haiti to the Windward Islands being in 18,000 feet of water. The recent survey for a cable between the Pacific coast and Manila justifies the belief that a route can be selected in which the depth will not exceed 20,000 feet and may not exceed 18,000 feet. The recent survey made by the Bureau of Equipment, Navy Department, under the direction of Rear Admiral R. B. Bradford, disclosed the greatest ocean depths heretofore known lying between Midway Island and Guam and being 31,614 feet, or but 66 feet short of six miles depth of water. This depression, however, which has been named the "Nero Deep," in honor of the vessel from which the sounding was made, can be avoided by a detour, and it is believed that the necessary depth will not exceed 20,000 feet and may not be more than 18,000 feet.

American Street Railway Association.

The headquarters of the American Street Railway Association during the convention, to be held in Detroit, on Oct. 8, 9 and 10, next, will be at the Cadillac Hotel, where the annual dinner will be held Friday evening, Oct. 10, when the officers-elect will be installed. The passenger associations have granted rates of one and one-third for the round trip. The following resolution was unanimously adopted by the executive committee: "The secretary is directed to request the chief executive officer of the different companies to notify all delegates and heads of departments attending the convention that they are expected to be present at all sessions of the meeting and take part in the discussions." A list of some of the papers to be read at the convention was given in our last issue.

Central Station Rates.

OWING to the interest aroused in the subject of central-station rates by the recent discussion at the Cincinnati Electric Light Convention, and in order to give our readers a view of the existing practice in charging for central-station current, requests were addressed to a number of central stations, so chosen as to represent as far as possible every section of the United States. Below are given a number of replies received.

MR. SAMUEL SCOVIL, Vice-President, Cleveland (Ohio) Electric Illuminating Company:

In the spring of 1899, the Cleveland Electric Illuminating Company adopted a differential system of charging for electric current for lighting purposes, as follows:

Twelve and one-half cents per unit (kw-hour) for 60 hours' use of all lamps connected, and 5 cents per unit for all current used in excess of such 60 hours' use in each month. In January, 1901, the 5-cent rate was made to apply on all current beyond 50 hours' use in any month of the lamps connected.

Our experience of over three years with this system of charging for current has been such that we can state that it has proven quite satisfactory to the company, and we believe it has also met with the approval of the great mass of the company's customers. It has the great merit of being easily understood by them. The monthly bills are always rendered in the same form, and the price for current used is always the same, yet the average rate paid by any customer for all current used may vary from month to month. This is one important point of superiority in the differential system, as against a graded scale system, where the price in the monthly bills must vary as the use of current varies.

This differential or two-rate contract contains a provision stipulating that in consideration of the 5-cent rate being allowed, the consumer guarantees to the company such a use of his installation as will insure to the company a gross sum, equal to at least 15 cents for each standard 16-cp lamp, or its equivalent. It is proper to mention in this connection, however, that the company does not insist upon a customer taking this two-rate contract. If he does not care to make a guarantee of 15 cents per lamp, he can secure the company's service at the base rate of 12½ cents per unit for all current he may use with a merely nominal monthly charge, which, however, also varies somewhat with the size of the installation. In practice, this results in new customers often taking the high-rate contract, and later changing over to the two-rate form, as they find that the saving in the darker months more than offsets the excess payment for current used in one or two of the lighter months.

The lamps connected, generally speaking, are the basis for arriving at the amount of current to be charged for at the high rate in the monthly bill, yet in order to avoid complaint on the part of any customer, the company is always willing to install a demand meter on his installation, and arrive through it at the amount of high-rate current to be billed, if used, in each month.

In the opinion of the writer, the "rationalizing" of central station charges must be in accordance with the costs' curves of the stations. No method of charging for current is rational or can be expected to prove satisfactory that does not make the charge to a customer conform to the cost of the company of furnishing to him the service which he requires of it, in connection with service furnished to other customers.

The cost to a company of furnishing service to a customer is made up of: first, investment and standing (fixed) charges, and, second, operating expenses.

Operating expenses are almost wholly in direct proportion to the amount of product supplied, but fixed charges on a given investment are the same regardless of the amount of product supplied by the apparatus representing this investment. Such being the fact, it is evident that the fixed charges' cost per unit of product of such apparatus is determined by the number of units over which these charges may be distributed. This means that a customer requiring a certain investment to be made in apparatus for his account, and who takes the product of such apparatus but one hour daily, cannot be furnished such product at the same rate per unit as can another customer requiring the same investment in apparatus, and who takes its product for two hours daily. In the latter case there are twice the number of units over which to distribute the same sum. If a customer takes such product ten hours daily, there are ten times the number of units over which to distribute the fixed charges' cost, as against the one-hour user.

I know that this reasoning is elementary, and particularly so for readers of your paper, but, nevertheless, I consider it advisable in discussing the problem of the proper method of making central station charges to call attention to this fact, for the reason that the almost universal practice so long pursued by the gas companies of selling their product at one price to all customers, regardless of the conditions under which the product is taken by the individual consumer, has caused even some central station managers to conclude that such a system is really the correct method of charging for service rendered. As a matter of fact, one price to all consumers alike is a most inequitable system, for it makes one customer, who makes a long use of the investment placed at his disposal by the supply company, pay more for the service which he requires than it would otherwise be supplied to him, because some other customer making a shorter use of the investment placed at his disposal is getting his service at less than it costs the supply company to furnish it to him.

The tendency on the part of electric supply companies to arrange their charges in such a manner that each class of customers will bear their proper proportion of the cost of furnishing the service which they demand, is not only based on common sense, but is forced upon the companies because of the conditions under which they work.

Gas companies are not under the same stress of conditions in the manufacture and distribution of their product. Nevertheless, it is a fairly debatable question whether their policy of maintaining one fixed price to all classes of consumers has not been detrimental to the growth of their business; that they have not nearly met the demand for gas possible on their part is to my mind well indicated by the relatively enormous per capita sale of the product which a natural gas company distributes in those localities where natural gas is obtainable. I do not mean to say that natural gas methods could be followed by an artificial gas company, for the natural gas people simply allow their service to become inadequate at times of maximum demand in a manner which would not be permitted by an artificial company. If the latter encouraged consumers to take its service, it would be compelled by public sentiment to install a distribution system which was adequate to furnish good service at the time of the consumers greatest need for it.

A gas consumer must pay a company's price or do without gas. Not so in the case of electricity. A goodly percentage of the users of electricity can arrange to make it for themselves, and as to other consumers, if their demand is not met by a company, competition, perhaps only for a limited district, at once follows, because such competition is comparatively easily arranged for. Because of these conditions, it is out of the question for a central station company to supply electricity at one flat price to all.

However, a central station company in arranging a system of charging in accordance with its costs should not charge a customer the cost of supplying him with the service which he requires considered by himself alone, but that cost which he occasions the company in taking his service with the service demanded of the company by other customers. That is to say, the diversity of the demands of the various customers must be allowed for in making the calculations as to what is necessary to remunerate the company for a certain class of service.

Now this means, if I understand it correctly, that as the uses of electricity becomes more and more diversified, it is reasonable to suppose that the peak load, which is so troublesome a factor at the present time, will become less pronounced, and as this peak widens it will be possible for a company using a differential system of charging to reduce its base rate to all consumers; but that this widening of the peak load will become so pronounced as to permit of one general flat rate, as was suggested at the last meeting of the National Electric Light Association, is, in my judgment, altogether out of the question (except, of course, in connection with a "readiness to serve" charge, which really simply means to the short-hour user a higher rate per unit for the limited amount of current he uses); so

far as one can look into the future at the present time, as to be not entitled to any serious consideration.

I repeat, therefore, that central station charges to meet the necessities of the situation must be in conformity with the cost curves of the stations, and these cost curves mean a graded charge for current supplied. Whether this graded charge be in the shape of a "readiness to serve" charge, plus a charge for current used, or be applied through a differential, or high first-rate and low second-rate, system, is not material, provided the public can be educated as readily to accept one system as the other. My observation is that the introduction of a "readiness to serve" charge will occasion friction between a company and the community it is serving. To the ordinary lay mind accustomed to gas usage, a "readiness to serve charge" seems entirely too much like paying out good money without getting any return for it; whereas a guarantee of use accompanying a graded scale system, applied directly in the shape of a scale or through a differential method, is in the nature of making a bargain. The consumer agrees to buy a certain amount of goods to be delivered in a certain manner, and secures a discount accordingly.

Mr. Paul Lüpke, Chief Electrical Engineer, South Jersey Gas, Electric and Traction Company:

Before meters could be had, our charges were based on the usual flat-rate plan. After duly passing through the agony of changing over to the straight meter rate system, I soon began to realize the truth of Mr. Doherty's opinion that "flat rates give us a loss of money by long-hour consumption, and meter rates a loss by short-hour consumption."

We were then compelled to meet the effects of a bitter war between two competing gas companies, in which gas was offered at 25 cents before the end came, and a combination settled the price at $1.00. It was evident that the straight rate of 15 cents per kw-hour, which was in effect at the time, would not meet the existing conditions, and I saw plainly that a straight cut could hardly be made deep enough to satisfy long-hour consumers, and would only serve to make short-hour consumers more unprofitable.

A 14 and 8-cent rate, as detailed below, was then made optional, and, rendering bills on both the straight 15-cent rate and the 14 and 8-cent rate, to make the advantages of the double-rate system plain to the consumers, soon brought about its almost general adoption.

The average yearly rate per kw-hour for all consumers, including the few still preferring the straight 15-cent rate, has been a trifle over 10 cents. We have recently made, in special cases, a further reduction to a 14, 8 and 6-cent rate, the 6-cent rate being charged for all consumption above double the minimum charge. The arrangement will probably be made general in the near future. For power service we charge 10, 5 and 3 cents per kw-hour.

Ever since the adoption of this plan, the business of the company has shown an uninterrupted and very healthy increase both in gross and net earnings; and although the gross earnings could probably be increased by any kind of reduction in price, I do not believe the net earnings will increase proportionately unless the reduction is made along the line of some rational double-rate system, which decidedly favors long-hour consumers.

The system we use, no doubt, is not ideal, but in practical use, extended over a period of four years, it has proved itself so valuable that I hardly think we will change for another unless very decided advantages can be shown.

Mr. J. H. Swinarton, General Manager, New York and Staten Island Electric Company; John Greenough, Receiver:

In our present unsettled condition, being in the hands of a receiver and undergoing a reorganization of the properties on Staten Island, we will refrain from expressing our views on the subject of rates for the present. We hope the reorganization will be completed on September 1st, after which time we may be in position to join in the problem of station charges, etc. I will give you, however, our rates for the present year. To commercial consumers of lighting, per kw-hour, 15 cents. To power consumers, between 7 A. M. and 6 P. M., 5 cents. Monthly settlements subject to discounts on meter bills when paid within 10 days from date of bills, as follows: Bills of $2 and under $5, 5 per cent.; $5 and under $10, 8 per cent.; $10 and under $20, 11 per cent.; $20 to $30, 14 per cent.; $30 to $40, 17 per cent.; $40 and upward, 20 per cent.

The minimum charge for any one month's service is $1.50, should meters show consumption of current of less amount. Commencing the first of this year we adopted the policy of free lamp renewals, which is working advantageously. We receive for arcs, 1200-cp., 34 cents per night, and for incandescents, 25-cp, $25 per year for lighting under the New York City schedule of hours of service.

Wyoming Valley Electric Light, Heat and Power Company, Wilkesbarre, Pa.:

The rate of this company for incandescent lighting is on a sliding scale, starting with 10½ cents per kw-hour up to 290 kw-hours and diminishing 1 mill with every succeeding 20 kw-hours up to 600 kw-hours; 40 kw-hours up to 1000 kw-hours; and 80 kw-hours up to 2000 kw-hours. The rate on current for motors is 10½ cents per kw-hour up to 80 kw-hours and diminishes 1 mill with every succeeding 5 kw-hours up to 100 kw-hours; 10 kw-hours up to 500 kw-hours; and 20 kw-hours up to 720 kw-hours. The following discounts are allowed off incandescent light and motor bills if paid on or before the last discount day as specified on the bill: 6 per cent. off on bills up to $28.35 inclusive and 5 per cent. off on bills over $28.35. No lamps are installed nor meter connected for a less rate than $1.00 per month. The company furnishes lamps, but lamps returned with the bulbs broken are charged to the consumer.

Mr. T. W. Pemberton, President, Phœnix (Arizona) Light and Fuel Company:

Our rate for alternating electrical current here is 20 cents per kw-hour, with discounts to some of our largest consumers. We have about completed a water power system here, and in the near future expect to change our method of handling customers as to rates, but are not in a position at present to give anything definite in this line. We favor the system of two rates, making a rate say of 20 cents per 1000 watt hours until each lamp has earned a certain quantity, and then to grade the rate perhaps by cutting it in two, making all over a certain amount 10 cents per kw-hour. The Chicago system that is now in use both for alternating and direct current strikes us as about the best that we have studied. We have a small town here, and instead of putting in two meters, we may make our difference by consideration of the maximum power installed and the maximum amount of lamps worked up, and reduce the rate from this determination.

Mr. A. W. Field, Secretary and Manager, The Columbus (Ohio) Edison Company:

The rate charged for current must be largely determined by local conditions. During the past four or five years this subject has been one of discussion in all the large associations, and in some of the State associations as well, with all of which we have kept in touch. During this time, however, we have not departed to any extent from our present method of charging for current. We use the T.-H. meters, and charge at a very low rate for large quantities of current, and at a moderate rate for smaller amounts, grading the service rendered by a careful analysis of the different classes of customers applying to us for current, based upon use of lamps connected, both as to hours and time when most remunerative to the station, or otherwise, offering special inducements to those who would enable us to use our machinery at a time when it would naturally be operated under a light load.

On general lines, we follow the principles of the demand system, but without the use of elaborate discounts, or investment in special demand meters. With us, this plan has worked quite satisfactorily; with other stations, or those operating under different conditions, it might not work so well. We have comparatively few complaints from customers in regard to inequality of rates, and those we have had we have been able to handle with little difficulty.

Mr. L. J. Moulton, Manager, Boulder (Colo.) Light and Power Company:

We have always had a fixed charge of 15 cents per kw-hour, with a discount for prompt payment. The other systems are confusing to customers, and after the experience of Denver in

this direction we are the more firmly convinced that the straight kilowatt-hour rate gives the best satisfaction, especially for plants of smaller size.

C. L. Edgar, President, Edison Electric Illuminating Company of Boston:

This company made a somewhat exhaustive study of the question of rates some years ago and finally decided to adopt the Wright or maximum demand system. This has been in use some three or four years and has given excellent satisfaction. I have read with great interest the discussions which have taken place from time to time on this general subject, but have seen nothing up to date which would suggest to us that our conclusions are wrong.

Mr. W. E. Moore, Superintendent, Augusta (Ga.) Railway and Electric Company:

The following system of rates was inaugurated about three years ago, and at this time applies to about one half of our output. We find that it generally works very satisfactory to the consumer, as the fixed charge and the low meter rate tend to equalize winter and summer bills, the difference between which has heretofore been a great source of dissatisfaction to the consumer. The fixed price of twenty-five cents is somewhat high, but this is due to the particular conditions under which we operate, as we rent water power from the city, based on a rating made once per year. The present system of rates is as follows: 1.—A payment of 25 cents per month as matriculation fee. 2.—25 cents per month rental for each meter installed. 3—25 cents per month for each 16-cp lamp demand of current used or contracted for. 4—4 cents per kw-hour for all power registered by meter. The above prices are all subject to a discount of 10 per cent. if paid on or before the tenth day after the date of bill. Renewals are supplied by the company. After contracting for a stated number of lamps demanded for one year, the demand cannot be increased except under a new contract made for one year from date of increase.

Mr. R. G. Hunt, Secretary and Treasurer, Fort Smith and Van Buren (Ark.) Light and Transit Company:

We sell all current for lighting purposes by meter measurement. In the business district (which we class A) our rates are much lower than in the residence district (which we class B), where cost of distribution is greater. However, some consumers in the business district take a class B rate, such as theatres, and factories that operate very little at night, yet require a connection. Below is the schedule of rates for the two classes:

	Class A. Cents per kw-hour.	Class B. Cents per kw-hour.
Less than 5 kw-hours	35	25
From 5 to 10 kw-hours	30	20
From 10 to 15 kw-hours	25	20
From 15 to 20 kw-hours	20	20
From 20 to 25 kw-hours	15	18
From 25 to 50 kw-hours	10	18
From 50 to 75 kw-hours	9	15
From 75 to 100 kw-hours	8	15
From 100 to 300 kw-hours	7	12½
From 300 to 1000 kw-hours	6	10
From 1000 or more	5	—

The above rates are based on a monthly consumption in kw-hours, as shown above. We find that the system has been very satisfactory as a whole. We have no charge less than $1 per month. We do not make any "cutting in" charges. Our power is sold flat.

Mr. C. J. Abbey, Superintendent and Electrician, Skowhegan (Me.) Electric Light Company:

The discussion on the topic of rates which gave rise to such great interest at the recent Cincinnati Electric Light Convention appealed to me particularly as a station manager for the past 12 years. I agree in the opinion that the most perplexing problem that the station manager has had to solve and adjust has been that of rates, and especially that of flat rates. It has been our aim to charge a customer for only the amount of energy consumed, yet at many times and in many ways this proved so misleading that we were forced to do one of three things; viz., run at a loss, raise our rates, or change to the meter system, and we adopted the latter. We are now getting returns for the total output of our plant instead of for about 50 per cent. of it, as on a flat rate basis.

After installing the meters we yet had the great problem of rates to puzzle over, and after giving every system due consideration, and realizing that whatever system we did adopt would be much more satisfactory not only to ourselves, but to our customers as to equality than the flat rate system, we adopted the sliding scale system, which appears to me as the most equitable of all systems in use. We charge the same for dwellings as for commercial lighting and do not give any discounts. For illustration, for the first 15,000 watt-hours 10 cents per 1000 watt-hours is charged, which puts the large consumer and the middle consumer on an equality with the small consumer up to that amount; for the next 15,000 watt-hours, 8 cents per 1000 watt-hours is charged, which places the large consumer on an equality with the middle consumer up to that amount. For over 30,000 watt-hours the charge is 5 cents per 1000 watt-hours, which allows the large consumer during the winter season to get the addditional lighting required at a minimum price. The cost of winter lighting is thus not as much per average hour as in the summer season, which I think appeals to our customers in a very satisfactory way.

I do not regard it equitable to make straight 10-cent, 8-cent, or 5-cent basis, or place any class on a straight basis, because there are times when the large consumer will step down to the middle consumer, and even down with the small consumer; and if he had a straight 5-cent rate during such times he would be getting his lights at a much lower price than the middle user, and for one-half that of the small consumer, which, in my view, is not strictly equitable. But by the sliding scale, when he steps down with the middle consumer he is a middle consumer and pays the middle consumer's rate; and he also pays the small consumer's rate when he steps down to him. I think to give a so-called large consumer a low price while he is a small consumer because he may some time, if he remains in business, use a larger amount, is a business error; first, because he may not remain in business long enough to compensate the producer for the advantage of the low price; and then again it costs more to supply him with energy during the time he is a small consumer than it does to supply the average small consumer, as there is a larger amount of capital invested in the plant lying idle subject to his requirements than for the small consumer. He should thus not be charged any less than the small consumer, as the rebate for his large consumption has already been provided for by the minimum rate, and I think until he reaches that rate he should pay as all others do for an equal amount consumed. Yet I will agree that circumstances of cases with respect to time of requirement as well as the amount of capital invested to supply the large consumer compared with the amount invested for an equal supply for small consumers, can be taken into consideration, which circumstances undoubtedly vary over a wide range in the many plants now in operation.

Mr. W. J. McManigal, General Manager, The New Omaha (Neb.) Thomson-Houston Electric Light Company:

As will be noted from the following schedule, our discounts for incandescent light is based on the total consumption of each 16-cp lamp per month. Or in other words, if a customer has twenty 16-cp incandescent lamps installed, and his meter shows a consumption of 100,000 watts, we would divide the watts by the number of lamps, which would give a total of 5,000 watts for each 16-cp lamp, which would entitle him to 30 per cent discount. As we are using a 6.6-ampere arc lamp, we figure one arc lamp as equal to eight 16-cp incandescent lamps. We have had this rate in effect for about six years, and it has proven entirely satisfactory.

The basic rate lighting service is 15 cents per kw-hour, with free renewals, subject to the following discounts on monthly bills: Up to 2 kw-hours, 10 per cent.; 3.5 kw-hours, 20 per cent.; 7 kw-hours, 30 per cent.; 15 kw-hours, 40 per cent.; over 15 kw-hours, 50 per cent. As stated above, an arc lamp is considered the equivalent of eight incandescent lamps, and a charge of 50 cents per month is added for the loan of an arc lamp.

For power, the basic rate is 10 cents per kw-hour, with discounts on monthly bills ranging from 10 per cent. for 200 kw-hours; 30 per cent. for 600 kw-hours, to 50 per cent. for over 900 kw-hours. The minimum charge is $3 per month.

EDISON ILLUMINATING COMPANY OF DETROIT:

In annual contracts covering all classes of service when the customer guarantees 30 hours' use per month of the demand, the rate of the first 30 hours is 16 cents per kw-hour and thereafter 5 cents per kw-hour. For incandescent lighting on open order with no guarantee, the first 60 hours' use monthly of connected load is at the rate of 16 cents, and thereafter 5 cents per kw-hour. For residence lighting, which is taken on open order and with a demand estimated empirically according to the size of the house, the first 30 hours' use monthly of the estimated demand is at the rate of 16 cents, and thereafter 5 cents per kw-hour. For power, intermittent, the rate is 10 cents for the first 30 hours' use monthly of the rated capacity of the motor, and thereafter at 5 cents per kw-hour. For power, continuous during regular shop hours not less than 48 hours per week, 5 cents per kw-hour.

Some important special rulings as follows: Approved direct-connected passenger elevators are supplied at 5 cents per kw-hour, and when the customer has an annual contract the elevator is connected outside of the demand indicator so as not to raise the demand. Elevators used intermittently are classified as intermittent power. Churches, social clubs open in evening only, theatres, etc., which under no circumstances require supply during the hours of the peak load, are given special rates; so are municipal and government buildings, for which annual contracts must be made. The total of all exceptions is about 5 per cent. of the business, the remaining 95 per cent. being on one or other of the regular forms. All bills under $50 per month are discounted 10 per cent. if paid on or before date due; $50 to $100, 15 per cent.; $100 and upwards, 20 per cent.

The system of rates now in use has conduced to a favorable change in the load factor, though this has been due to several causes. The first cause is the addition of a great deal of power supply. A shop running ten hours a day for 300 days a year uses its power for 3000 hours annually. Such a shop is not so good a customer as would be a municipality requiring street lighting for 3900 hours per annum, or an all-night restaurant requiring light for about 4400 hours per annum; but the workshop is a very much better customer than many others, such as the tenants of office buildings who require light only from dusk until 5:30 during the winter months, to a total of 150 hours per year; or wholesale merchants closing their premises 6 o'clock week days all the year round and requiring about 250 hours lighting per year. The increase in the power business has been very marked, and it still continues. To some extent this has been in response to low rates, but the more important factors have probably been the great reduction in the price of direct-current motors, the increased durability of modern motors, and the education of the machine-using public to the convenience of electric power.

The second cause which has led to a change in the character of the business has been the system of differential rates for lighting under which long hour use of light has been favored by low rates. The result of this second great cause will be evident to anyone who will mentally compare during the late evening the lighting with remembrance of that lighting five years ago. There is not only a more general use of electric light by such stores as are open, but the windows of the stores which are closed are brilliantly lighted for the exhibition of goods; and electric signs and what may be termed decorative lighting are in insistent evidence.

The differential rate system has been applied also to residence lighting. Four year's experience, however, shows that while householders do really under the differential rate system, use light more liberally than under the single rate, they do not and will not change their habits to such an extent as to cause a rapid improvement of the load factor. There is no mistake about such improvement as has taken place in the load factor of residence lighting, but it is a small improvement in comparison with the improved load factor of the business lighting. There is virtually no power business to be had from residences. The use of heating devices, such as laundry irons and the charging of storage batteries for automobiles, are trifling items in the load curve of a residence district, and householders cannot be coaxed by the offer of a low differential rate to leave their windows illuminated until ten o'clock at night, as now do the Woodward Avenue stores.

MR. W. J. KEHL, Manager Electrical Department, New Orleans and Carrolton Railway Light and Power Company:

This company has four forms of contract, as follows:

1. For small users, as in the case of offices and residences. For this service a guarantee is exacted of $1 monthly on 1 to 10 lights, $1.50 on 10 to 20 lights, and $2 on over 20 lights. The basic rate is 20 cents per kw-hour with a discount of 5 per cent. on monthly bills from $1 to $10; 10 per cent. on bills from $10 to $15; 15 per cent. on bills from $15 to $25, and 20 per cent. on bills of $25 and above. An additional discount of 10 per cent. is allowed for prompt payment. Lamp renewals are furnished free.

2. A long-burning rate, which is granted where electricity is used exclusively, the consumer guaranteeing to use current to the amount of 40 cents per month for each 16-cp lamp installed. This rate applies particularly to saloons, small clubs, cigar stores, etc., where the entire installation is used two or more hours daily. The rate is 20 cents per kw-hour, with 50 per cent. discount when the consumer exceeds 40 cents per month on each 16-cp lamp installed, or its equivalent. Ten per cent. additional discount is accorded for prompt payment of bills.

3. A long-term contract, which is made for a period of three years, and only given to the largest consumers. The smallest guarantee in this contract is for $15 monthly. This rate applies to larger stores, theatres, clubs, and such other places having a large installation burning several hours daily. The basic rate is 20 cents per kw-hour, with discounts ranging from 5 and 25 per cent for 25 kw-hours; 20 and 25 per cent. for 250 kw-hours, to 40 and 25 per cent. for over 2,000 kw-hours.

4. A power rate, which was adopted March 1 last. The basic rate is 10 cents per kw-hour, with discounts on monthly bills ranging from 10 per cent. for bills of $10; 25 per cent. for bills of $25; 40 per cent. for bills of $50; to 55 per cent. for bills of $200 and over. In both the above cases the usual discount of 10 per cent. is allowed for prompt payment.

The conditions in New Orleans are such that there are but few places where current is required for lighting earlier than dusk, except on very dark and cloudy days. There are no cellars or business places underground or requiring artificial light during the day. On account of the semi-tropical nature of the climate, houses are built with the view to obtaining all the air and natural light possible; no one could, therefore, be prevailed upon to use light during the day, no matter how low the rate. The system of rates adopted has been largely based upon these considerations.

MR. P. J. BALAGUER, Secretary, Charleston (S. C.) Consolidated Railway, Gas and Electric Company:

After careful investigation of the various systems in vogue at that time, of charges for light and power, this company, in 1899, deemed it advisable to adopt the following system of charging its patrons for current, namely, a meter basis for current furnished, with a graduated scale of discount in proportion to consumption of each individual consumer. With the exception of power for fans and current for commercial arcs, we deal with the public on a meter basis entirely. This system has been carefully followed up, and we find that it gives entire satisfaction, not only to the public but ourselves.

The rates for series arc lamps are $12 per month for all-night lights, and $10 for lights to midnight or 1 A. M. For power, the rate is 7 cents per kw-hour, with discounts on bills, as follows: $21 to $40, 5 per cent.; $41 to $80, 7 per cent.; $81 to $160, 10 per cent.; $161 to $320, 15 per cent.; over $321, 20 per cent.

The rate for incandescent lighting is 15 cents per kw-hour, with discounts on bills, as follows: $11 to $20, 3 per cent.; $21 to $40, 5 per cent.; $41 to $80, 7 per cent.; $81 to $160, 10 per cent. For larger amounts, the discounts gradually increase to 25 and 10 per cent. for bills of $600 and over.

For meters, transformers, service wire, etc., there is a monthly charge ranging from $1 for from 1 to 5 lights; $2 for from 6 to 10 lights; up to $9 for from 300 to 400 lights.

MR. C. R. MAUNSELL, Superintendent, Topeka (Kan.) Edison Electric Illuminating Company:

I give below a schedule of our rates that was gotten out some time ago. We are now contemplating a new schedule, and will base our charges on the kw-hour entirely, as it has been my experience that the public does not care to investigate our business; what it

wants is a net bill, based on the simplest possible method of reading the meter. We have used the two-rate meter to some extent for power users, and it is our experience that the majority of power users endeavor to conduct their business so as to take advantage of the low rate. This system has worked very satisfactorily in general, one favorable result being that it has materially lowered our peak load during the winter months. In view of this situation, we shall continue to encourage the use of the two-rate meter for all customers.

This being a small town, but with a great number of office buildings, we find that the minimum charge of $1.50 per month per meter discourages the undesirable customer from asking for service, and leaves us with the people who use light the year round. To sum this matter up in a few words, it is our experience that a minimum bill in combination with the two-rate system, together with a system of discounts on the total of bills, will serve the greatest number of central stations.

For incandescent installations a charge is made for connecting to street mains, varying from $3.50 for 10 lamps to $8.00 for over 40 lamps. Renewals are furnished free. The minimum monthly charge for 5 or less lamps is $1.00, and for more than 5 lamps, 20 cents per lamp; the charge being based upon the number of lamps applied for as available at one time. For 1 kw-hour up to the minimum mentioned, the rate is 14 cents, and 8 cents per kw-hour for current used in excess of the minimum. Should this straight-meter rate be elected, the charge is 15 cents per kw-hour, with the charge for connecting as above.

For power, the charge for connecting is $3.50 up to 3 hp, and $5.00 for greater capacities. The minimum monthly charge for 1 hp and less is $2.00, and for more than 1 hp, $2.00 per hp, based upon the actual (not rated) capacity of the motor. Up to the minimum named, the rate is 10 cents per kw-hour; 5 cents per kw-hour to double the minimum, and 3 cents per kw-hour for excess of the latter quantity.

The rates for 9.6-ampere series arc lamps, all night, every-night service, is $10 per month; for service from dusk to 11 P. M., seven nights per week, $7, or $6 per six nights per week. A reduction is made for other than all-night lights, if more than one lamp is used; for example, the rate for four lights are $23 and $21, respectively. For motors, the charge is 5 cents per hp-hour. For incandescent lighting the rate is, with free lamp renewals, 1 cent per 16-cp-hour, with the following discounts on bills: Up to $5, 5 per cent.; to $10, 15 per cent.; to $30, 20 per cent.; to $50, 22 per cent., and 25 per cent. for larger bills. An additional discount of 2½ per cent. is allowed for prompt payment.

Mr. Chas. H. Kintner, General Manager, Harrisburg (Pa.) Light, Heat and Power Company:

Following are the regulations and rates of our company: Worn out lamps are replaced by the company, but lamps accidentally broken are replaced at the expense of the consumer. No meter is installed for commercial or residence lighting for less than a minimum rate of $1 per month. Bills are rendered according to meter registration in all cases where consumption is in excess of the minimum rate. The rates are 15 cents per 1000 watt-hours, subject to the following discounts: On bills from $1 to $20, 5 per cent.; from $20 to $50, 10 per cent.; from $50 to $75, 15 per cent.; from $75 to $100, 20 per cent.; from $100 and over, 25 per cent.

Mr. T. R. Beard, General Manager, Poughkeepsie (N. Y.) Light, Heat and Power Company:

The rates charged for electric current by this company are for light 15 cents per kw-hour with discounts varying from 5 per cent. to 35 per cent., according to quantity. The price for power is 10 cents per kw-hour with discounts varying likewise from 5 per cent. to 35 per cent. Much of our business is done at special rates, and as far as possible we endeavor to take into account the current furnished and the maximum number of lamps required, having been attracted to this method of charging by the numerous articles in the recent magazines. We have no extended experience that would be of interest, since we have only undertaken the management of this plant.

Mr. Geo. A. Redman, Superintendent, Rochester (N. Y.) Gas and Electric Company:

The question of rates is one that is troubling all central station managers at present. We have tried several systems, but have now decided to give our present schedule a thorough trial. It is based, as will be seen below, upon the amount received per lamp per month, and the discount is based on use of same.

Electric current for arc lamps is charged for at the rate of 10 cents per kw-hour, bills being based per lamp installed. The discounts are, on $4, 40 cents; $8, $2.40; $12, $6, and $13, $6.50. Current for power is charged at the rate of 7 cents per kw-hour, the discount on bills being based per hp installed. The discounts are, on $1.40, 7 cents; $5, $1.90; $9, $5.15; and $14, $8.40. Current for incandescent lights is charged at the rate of 14 cents per kw-hour for residential, and 10 cents per kw-hour for commercial use. The discounts on amount of bills per lamp installed are, on 50 cents, 4 cents; 80 cents, 12 cents; $1.00, 23 cents; $1.50, 60 cents; $2.00, $1.00; and $2.45, $1.32. On all bills an additional discount of 10 per cent. is allowed when paid on or before the 10th of each month.

Electricity in the Naval Manoeuvres.

Capt. E. L. Zalinski, U. S. A., writing to the New York *Herald* about the preparations for the army and navy manœuvres on Long Island Sound, says:

"Numerous searchlights are placed in every advantageous position in the different batteries. Some are said to have been placed in advanced positions beyond the works. The attacking enemy is sure to be greeted with a flood of light from the projectors, which will be followed by a shower of well-directed missiles from the guns of the fortification.

"The lights striking the eyes of those who are steering the ships and aiming their guns have the effect of momentarily blinding them. It will thus be very difficult either to steer the ship or aim the guns properly. Much of the electric installation is of a temporary character, and cables are lying on the ground or on makeshift supports of old barrels, boxes, etc. In some of the works the engines, boilers and dynamos are in temporary buildings of rough boards and tar paper.

"Among the interesting appliances newly introduced is Professor Elisha Gray's telautograph, or writing telegraph. The officers who have used it speak warmly of its efficiency and usefulness. It appears now to be entirely practical and is not affected by rough handling or by the shock produced when firing the heavy guns. Its records are legible and cannot be mistaken or questioned, as may be the telephone. Any man of average intelligence can in a few minutes learn to operate it.

"The Signal Department has placed wireless telegraph outfits at many suitable places, some in advanced positions. Balloons are also prepared for ascents, which should give extensive fields of view and enable detection of the movements of the enemy's fleet, even at night, unless in a fog."

Copper Production and Consumption.

According to the official data of Mr. Charles Kirchhoff, the total production of domestic copper in the United States in 1901 was 268,782 long tons, as against 270,588 long tons in 1900. The estimated consumption of copper in the United States in 1901 was 382,761,014 pounds, as against 356,891,121 pounds in 1900.

The stock of copper on hand in the United States on January 1, 1902, is estimated as having been at least 300,000,000 pounds, equivalent to six months' production.

The copper market opened in 1901 rather dull, at the official prices of 17 cents for Lake and 16½ cents for electrolytic, but actual sales were made at 16⅞ cents for Lake, and at 16¼ cents for electrolytic. By the 13th of January, 1902, the official prices had fallen to 11⅛ cents for Lake copper.

The world's production of copper in 1901 was 511,803 long tons, as against 487,206 tons in 1900, 463,693 tons in 1899, and 429,379 tons in 1898.

Electro-Metallurgical Development at Massena.

One of the largest and most interesting water power developments in this country is that at Massena, on the Grasse River, a tributary of the St. Lawrence, about thirty-eight miles northeast of Ogdensburg and ninety-five miles southwest of Montreal. At this point, during the past few years, the Saint Lawrence Power Company has developed a very large power by means of a canal 16,200 feet long, and from 18 to 20 feet deep, with a width at the water line of 192 feet. At the end of the canal the water has a velocity of about three and a half miles an hour, and there is a fall of between 45 and 50 feet at the point where the power house was erected. The power house, which is shown in one of the engravings herewith, will have a total length, when completed, of nearly 700 feet, with a width of about 150 feet. The full power plant laid out includes fifteen Victor turbines of Stilwell-Bierce & Smith-Vaile make, set in sets of 6 wheels each on horizontal shafts about eighty feet long, each set operating a 5,000-hp generator. There are three draft tubes to each turbine chamber, each 10 feet in diameter, two turbines discharging through each tube. On the bedplate at the mouth of each draft tube are set also two Victor turbines of 1,000 hp each, regulated by electric governor in the power house; and there are other wheels, each 27 inches in diameter, for the exciters, two to each exciter, running at 275 r. p. m. The present generators are three-phase Westinghouse machines of 5,000 hp, each 2,200 volts, 3,000 alternations; speed 150 r. p. m. The three exciters are of 400 hp each, at 125 volts.

The St. Lawrence Power Company has already spent several million dollars on its enterprise, but in some way has failed hitherto to attract due public notice, so that it has encountered difficulties in marketing its power, developed at so much initial cost, but vieing in cheapness with anything known on this continent. Such magnificent resources of energy could not, however, long go begging in these busy days, and a new era appears to be opening for the company, as evidenced by the interesting views given herewith. As is well known the aluminum industry in the United States has taken on an enormous development, the production for 1901 being placed officially at no less than 7,150,000 pounds, thanks to the efforts of the Pittsburg Reduction Company. That concern, which was first seated at Pittsburg, using coal, has for some few years past been located at Niagara; and it now makes a further very important move in the direction of obtaining cheap power by going to Massena where it has taken property to the extent of 100 acres, and is now erecting works. The two engravings show the works as they will appear when finished and their topographical relation to the power house, canal, etc. There will be twelve buildings in all, presenting a compact block 1,500 feet wide and 2,900 feet long, with access at the southwest corner to the adjacent power plant. There is also a front 650 feet long on the canal, where the Pittsburg Company can at any time in the future, should sufficient demand arise, erect a power house for itself.

The contract under which the Pittsburg Company takes power from the St. Lawrence Company provides for an initial 12,000 hp, but there is an option on a total of 25,000 hp. The Pittsburg Company will, it is rumored, develop at Massena other electro-metallurgical or electro-chemical work requiring current in large volume, besides the production of aluminum. It uses direct current, and as nothing could be gained by the conversion, for so short a distance of the three-phase alternating current for that purpose, the Pittsburg Reduction Company has made a contract with the Bullock Electric Manufacturing Company for four direct current generators of 2,200 kw each, at 140 revolutions.

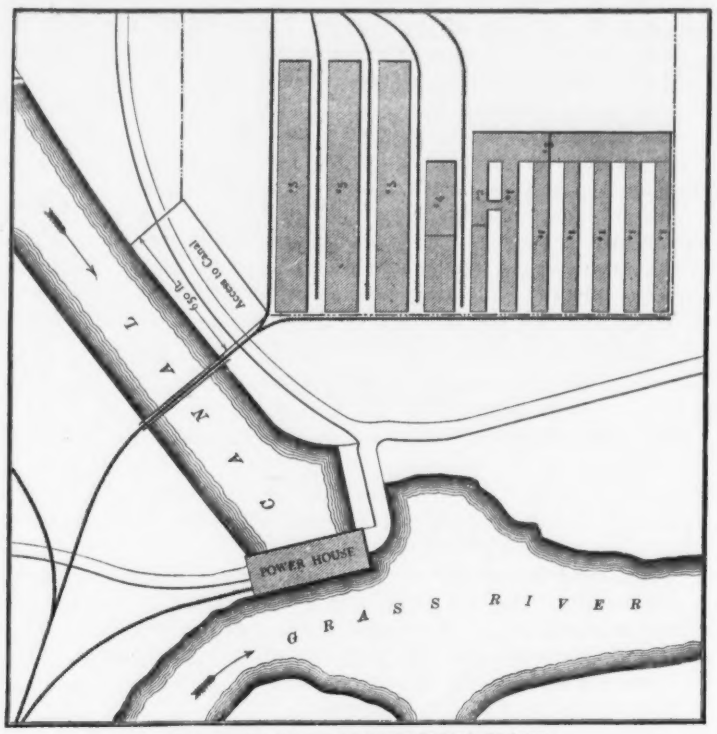


FIG. 2.—PLAN OF THE MASSENA PLANT.

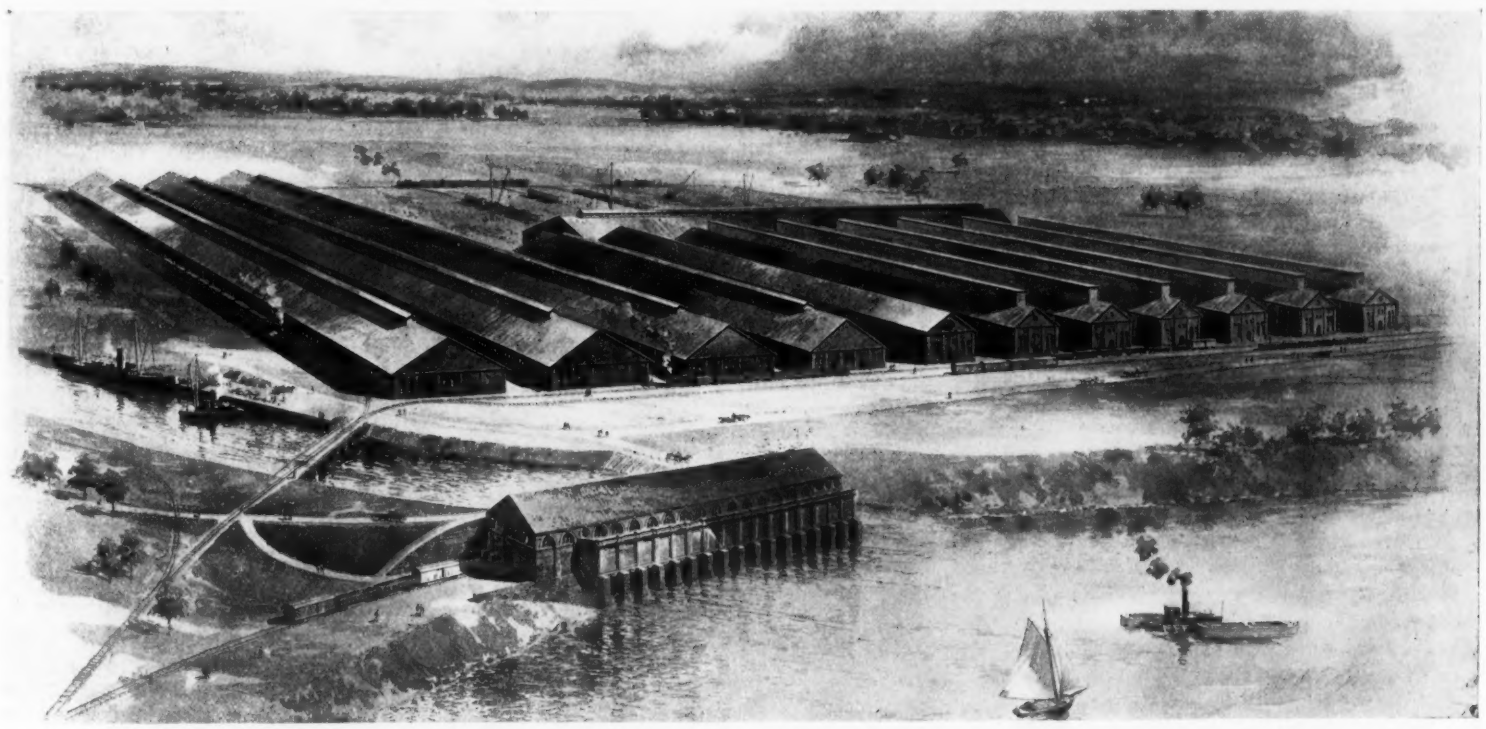


FIG. 1.—GENERAL VIEW OF ELECTROMETALLURGICAL PLANT AT MASSENA.

Rational Electromagnetic Units.

SIGNOR Giovanni Giorgi about two years ago brought before an Italian Congress of electrical engineers and physicists a system of rational electromagnetic units, which was referred to a committee for report. Recently this committee, which consisted of Prof. Roiti and four other prominent Italian scientists, recommended the adoption of the system. Signor Giorgi has made his system the subject of a paper communicated to the Physical Society of London, which paper we reproduce below.

It is now generally acknowledged that the system of electric and magnetic measures at present in use is open to an objection, insomuch as it includes an unnecessary factor 4π in the definition of the fundamental units of electric charge and magnetic pole.

We are indebted to Mr. Heaviside[1] for having first expounded the argument. He pointed out, as far back as 1882-83, that the origin of what may be called the "irrational" or "spherical" factor lies in the inverse-square formula, which was formerly adopted as fundamental. The equation for the intensity of field emanated from an electric or magnetic mass had in fact been written thus:

$$F = \frac{m}{l^2} = \frac{4\pi m}{S}$$

while, rationally it ought to be

$$F = \frac{m}{4\pi l^2} = \frac{m}{S}$$

where S is the area of the sphere on which the flux of induction at a distance l from the mass is spread.

From the first, or irrational, formula, the set of units in use has been deduced. Hence the origin of the spherical factor which runs throughout the whole system and appears everywhere in equations that have nothing to do with spherical or cylindrical bodies.
I quote, for instance, the following cases:

(a)—Capacity of a plane condenser:

$$C = \frac{\kappa}{4\pi}\,\frac{S}{d}$$

(b)—Characteristic equation of magnetism:

$$u = 1 + 4\pi\kappa$$

(c)—Magnetic work, per unit volume of a medium:

$$dw = \frac{1}{4\pi}\,\mathfrak{H}\,d\mathfrak{B}$$

No doubt, the student who meets for the first time equations of this kind, is induced to think that 4π arises mysteriously from the most intimate nature of electromagnetic phenomena; so that if a day were to come when circles and spheres would be abolished from the world, we ought then to define π electromagnetically, and determine its value by measuring the energy of magnetization of a medium, or the capacity of a plane condenser.

These incongruities are removed when the system deduced from the inverse-square law is rationalized, by restoring the 4π to its right place. No doubt, the change is easy, so far as the presentation of the theory is concerned; there can be no divergence of opinion on the grounds which support it. But the difficulty arises as to the units to be employed for practical measurements. The electric and magnetic units already adopted and legalized throughout all civilized countries have been established in accordance with the spherical definition. What is to be done with them, in view of the results of the rationalistic principle?

Mr. Heaviside insisted upon the necessity of a general reform, and the adoption of a new volt, a new ampere, etc., all at variance with those at present employed. This is a good plan and grounded upon excellent reasons; but the opposition which is likely to be raised against its practical application cannot be ignored, and it is rightly believed that to insist upon a proposal like this would have the effect of delaying the adoption of the rational theory beyond any reasonable limit.

Two years ago Prof. Fessenden[2] and Prof. Fleming[3] advocated another plan, consisting of a partial change of units. Objection was raised against this reform, that it is not radical, and again it implies departures from the accepted systems. The question has been discussed further, but it still remains unsettled.

[1] See O. Heaviside, "Electrical Papers," (I) 199, 263; (II) 543; also "Electromagnetic Theory," (I) x, 116; (II) 275; in the latter references are given.

[2] See The Electrical World, Dec. 9, 1899.

[3] See The Electrician, Dec. 29, 1899; Jan. 5 and 12, 1900.

I propose here to show how, in my opinion, the question might be considered under another point of view, and then a solution derived, whereby the present practical systems of measures would be brought into agreement with the rationalistic theory, without either introducing new units or altering those already in use[4].

The principle from which the theory of the rationalization depends may be explained as follows:

When a quantity of electricity, or electric flux, dg, is displaced against an electromotive force e, the work performed is reckoned by

$$dw = e\,dq$$

or writing p for the activity of the electric current i, we have

$$p = ei$$

The magnetic analogue to electric displacement is magnetic flux, and the force acting on it is the magnetomotive force. Consequently the work performed when displacing a flux $d\phi$ against a magnetomotive force $\mathfrak{M}$, ought to be rationally expressed by:

$$dw = \mathfrak{M}\,d\phi$$

or, if $g = \frac{d\phi}{dt}$ is called *magnetic current*, we have its activity:

$$p = \mathfrak{M}\,g$$

The equations of activity, thus, define the rational units of *E. M. F.* and *M. M. F.* in terms of those of electric current and magnetic current, when the unit of energy is supposed given.

Now, on comparing our equations with those commonly written, we notice that the first one is unchanged, while the other, in the ordinary system, is written with a divisor 4π. Therein precisely lies the irrationality.

We see, however, at the same time that this irrationality affects but one side of the ordinary system. It appears that stress on this remark has not yet been laid by those who have hitherto written on the rationalization of units. I see in this the strongest argument in favor of the rational theory. For if spherical measures were preferable, the ordinary system ought to be likewise rejected, as not being entirely inclusive of them. These remarks explain also the scheme for a partial reform suggested by Prof. Fessenden.

The reason of the one-sided irrationality is that the usual formulas alluded to are those of the electromagnetic system—that is, deduced from the inverse-square law for magnetism; therefore, the spherical factor is limited to the magnetic equations only. These formulas do not agree with those deduced from the inverse-square law for electricity, or electrostatic formulas; therefore, it has not been possible to introduce the spherical measures both in electricity and magnetism at the same time. This is a reason why all systems grounded upon spherical measures are necessarily unsymmetrical. On the other hand, it is possible to build out a system wherein all measures are free from the 4π and mutually agree with each other; and then the strict symmetry between electric and magnetic formulas are restored.

The above arguments lead into a wider field of inquiry. It often happens that the advantages or disadvantages of a reform of "the usual units" are spoken about, without clearly stating what system of units is alluded to. Now, for practical calculations the units employed are those of the so-called practical set, which includes the volt, ohm, ampere, and similar ones. This set has not been extended to include several other electrical and magnetic units, nor any practical unit of length, mass, area and volume.

This is not an absolute system and may be considered as not bearing any fixed dependence from the theoretical formulas; therefore, the problem of the rationalization does not necessarily touch it.

All theoretical formulas are written with implicit reference to absolute or *C. G. S.* units. These, on account of their inconvenient size could not be adopted for the purpose of calculations, either in the industry or in laboratory practice, but the mathematical theory of electrical phenomena is usually expressed in terms of them. Now, it is to be remembered that the *C. G. S.* systems are in fact two, I mean, the "electrostatic" and the "electromagnetic." The conflict between them arises from the omission of a *physical factor*, viz., the electric or magnetic constant of free ether, just as the intrusion of the 4π arises from the omission of a *mathematical* factor in the formula of the inverse-square law.

These are, in fact, two irrational features which have simultaneously intruded themselves in the system. And I wish here to point

[4] The present paper is the theoretical development of a scheme which I ventured to lay down in a lecture at the meeting of the Associazione Elettrotecnica Italiana, held in October, 1901. See "Unita Razionali di Elettromagnetismo," in Atti Dell' Associazione Elettrotecnia Italiana, Vol. v, fasc. 6.

out that its rationalization implies that it must be ultimately recast. For, how can a system be called rational so long as the electrostatic and electromagnetic measures are kept distinct? Is it reasonable to correct by 4π the definitions of electric and magnetic mass, and still allow that they conflict together? Therefore, I think that the problem of the elimination of the spherical factor ought not to be distinguished from that of the unification between electrostatic and electromagnetic measures.

It may be remarked that, to attribute to either of the fundamental constant the value unity may at first sight appear a simplification; but the two assumptions cannot be introduced simultaneously[6], so that they necessarily lead to unsymmetry. And moreover, the simplification searched for has no other effect than to lead to a mistake. When either constant is measured by unity, it often happens that its existence is forgotten, and then confusion is made between quantities, such as magnetic force and induction, which are physically as distinct as might be *E. M. F.* and current in a circuit of a unit resistance.

There are therefore proper reasons for having both ether constants measured by other values than unity. But, when these assumptions are discarded, the inverse-square laws cease to bind to any particular choice of units, and we must look elsewhere for the scientific basis of a rational system.

We have already written the rational expressions for electric and magnetic activity. Suppose now that an electric and a magnetic circuit are *interlinked* together, so that the work developed by one is recovered by the other. In this case the activities are equal and opposite, so that

$$\pm e\,i = p = \mp \mathfrak{M}\,g$$

But these interlinked currents constitute an *electromagnetic loop*, to which the two circuital equations are applicable; these are:

$$e = \mp g \qquad \mathfrak{M} = \pm i$$

We have thus a set of four, or rather three equations, which contain explicitly the four concrete units of *E. M. F.*, *M. M. F.*, electric current, magnetic current, together with that of activity.

These equations, instead of the inverse-square laws, are to be considered as fundamental in the electromagnetic science. They are necessary and sufficient for it. I may observe that by application of space differentiators it is easy to convert them into differential equations of the field, of the most general type, which includes the laws of propagation of electromagnetic disturbances and light waves. For our present purpose, however, the finite form is preferable.

On considering the cross-connections established by the circuit laws, we notice that the fundamental units needed are reduced to a common one for *E. M. F.* and magnetic current, and to another for *M. M. F.*, and electric current. Their product must reproduce the mechanical unit of activity; in the limits of this condition, their choice is entirely arbitrary.

No scientific reason of any kind may be assigned for preferring any particular choice to another. We are free to select any set of values which suits to practical convenience.

If the *watt* is assumed as unit of activity, we have two units ready made, the *volt* and the *ampere*, which satisfy the condition. Let us assume them as fundamental. This will be on the strict understanding that in the rationalized system they are introduced not as defined by theoretical relations, but in an empirical way. Thus the ampere will be the current which decomposes a stated quantity of silver nitrate; if asked the reason for it, we answer that theoretically all values are equally good, and we have adopted this particular one, because we found it already employed in electrical engineering.

Accordingly, we write down our fundamental set as follows:

Electromotive force=VOLT=Magnetic current.

Electric current=AMPERE=Magnetomotive force.

The product of these gives:

Electric activity=WATT=Magnetic activity,

reproducing in a double form the same mechanical unit.

From the fundamental set here assumed, a complete system of electric and magnetic units can be deduced. This system is rationalized. Therein, the relations between electric current, magnetic current and electromotive force stand as usually written. A change is introduced in the magnetomotive force, on account of the suppressed 4π. But no fresh unit is required for it; the rational measure of *M. M. F.* is simply in amperes. Practicians already employ it under the (improper) name of *ampere-turns*.

[6] Strictly speaking, this is not absolutely impossible; but it would require to reject Ampere's equality, which has practical reasons for its support.

In order to get rid of all other concrete units of electricity and magnetism, it is sufficient to combine together the volt, the ampere, and the second, in various forms, and interpret the results suitably.

The product of the ampere into the second is called *coulomb*. This gives:

Electric flux=COULOMB=Magnetomotive impulse,

and here the dualistic signification is illustrated when discharging a condenser into a ballistic galvanometer.

The product of the volt into the second, which has been called *weber* by the *B. A.*, gives likewise:

Electromotive impulse=WEBER=Magnetic flux,

and here the physical illustration is obtained when exploring a magnetic field by means of a secondary coil.

The ratio volt: ampere is the *ohm*, and the reciprocal ratio is sometimes called *mho*. In electrically or magnetically dissipative circuits, their interpretation is as follows:

Electric resistance=OHM=Magnetic conductance.

Electric conductance=MHO=Magnetic resistance,

and when dealing with alternating circuits, the *ohm* and *mho* are also the units for electric and magnetic reactance and impedance, susceptance and admittance. There are, of course, no magnetically dissipative bodies hitherto known, but apparent magnetic conductance (due to hysteresis), and reel magnetic susceptance and admittance are to be found in circuits subjected to alternating induction.

When a circuit is not dissipative, but electrically accumulative, the ration between quantity of electricity and *E. M. F.* is commonly called *capacity*, but the scientific name for it would be *electrostatic inductance;* the reciprocal quantity is *electrostatic reluctance.*

Their units of measure are the $farad = \frac{ampere \times second}{volt}$ and its reciprocal, for which no name has been coined. Looking from the magnetic side, the same quantities are exhibited as inertia and mobility, as follows:

$$Electrostatic\ inductance = FARAD = Magnetokinetic\ inertia.$$

$$Electrostatic\ reluctance = \frac{1}{FARAD} = Magnetokinetic\ mobility.$$

The electrostatic inductance and reluctance have been called *permittance and elastance* by Mr. Heaviside; these names appear, however, not to be entirely free from objection.

Any circuit made out of known bodies is magnetically accumulative. Therein, the ratio between the rational measures of magnetic flux and *M. M. F.*, is defined as *magnetostatic* or *magnetic inductance* (in the irrational system we have, instead of it, the *permeance;* it is advisable in order to avoid changes to continue to use this word in the signification now attached to it); its reciprocal is *magnetic reluctance.* Electrically, these quantities are exhibited as electrokinetic inertia and mobility. Under the electrical meaning, the rational unit *henry* has already been defined as $\frac{volt \times second}{ampere}$ so that we have but to acknowledge its magnetic signification. We have thus:

$$Electrokinetic\ inertia = HENRY = Magnetostatic\ inductance.$$

$$Electrokinetic\ mobility\ \frac{1}{HENRY} = Magnetostatic\ reluctance.$$

A caution must here be made, namely, that when simply "the inductance" of an electric circuit is mentioned, its magnetic, not electric, inductance has to be understood.

We conclude then, that the electric and magnetic concrete units in present practical use do not need to be altered, but only to be properly interpreted in order to fall into agreement with the formulas of the rational theory. Ten units are sufficient for the rational measure of all concrete quantities of electricity and magnetism, each one being taken in a double signification.

Now, as far as the relations of these quantities with each other and with energy and time are considered, the system is absolute. But in order to have it complete, it is necessary to introduce a set of specific units; and for this purpose a unit of length is required.

This is just the weak point of all systems employed up till now; for, as they always rest upon the unnecessary assumptions attached to the inverse square formulas, electric and mechanical units of reasonable size cannot consistently fit together. But if this chain is rejected, we are free to choose whatever units of length and mass we like, the only necessary link with the electric measures being that they reproduce the same unit of power.

For instance, the *meter* and *kilogram* are consistent with the

watt. If they are put together with the units hitherto enumerated, an absolute system meter-kilogram-second may be built up, which covers up electric, magnetic and mechanical measures in a perfectly consistent frame. This system consists entirely of units already in use; nevertheless it is strictly rationalized—that is, not only free from the 4π, but at the same time "electrostatic" and "electromagnetic." It is equally applicable for theoretical and practical calculations, thereby the *C. G. S.* system ceasing to be necessary.

The specific measures in an absolute system are defined by referring the concrete measures to the unit length, unit area, unit volume. Thus, whatever be the fundamental unit of length adopted, the specific units of electric force and electric induction, will be *volt per unit length,* and *coulomb per unit arc;* those for magnetic force and magnetic induction will be *ampere per unit length* and *weber per unit area;* and so on. Similarly the resistivity and conductivity of a body would be defined as the resistance and conductance of a cube of unit dimensions, and measured in *ohms into unit length* and *mho per unit, length.*. Finally, the definition of the electromagnetic constants of a medium is arrived at as follows:

The electrostatic constant or *electric inductivity* is the ratio between electric induction and force in a medium; it is to be measured in *farads per unit length,* the symbol κ being employed for it. Similarly, the magnetostatic constant or *magnetic inductivity* of a medium is the ratio between magnetic induction and force therein; this is to be measured in *Henries per unit, length.* I suggest to represent by the symbol λ the quantity thus defined.[7]

But the electric and magnetic inductivities of a substance can be also defined as the electric and magnetic inductance of a cube of unit dimensions. Thus, the electric inductance of a plane condenser, and the magnetic inductance of a straight core are given respectively by

$$C = \kappa \frac{S}{d} \qquad L = \frac{\lambda S}{d}$$

where, in both cases, S is the section, d the length or thickness of the induced body.

8. Stress must be laid on the fact that in the M—Kg—S system, none of the fundamental and derived units would have an absolute value.

Therefore, it is instructive to investigate by what numbers the two constants of the ether, κ_0 and λ_0 are measured in the units of this system. We get

$$\kappa_0 = 0.\ 000\ 000\ 000\ 008\ 842$$
$$\lambda_0 = 0.\ 000\ 001\ 256\ 637.$$

These values are not to be looked upon as an abnormal feature of the system; on the contrary, they express a physical truth. They instruct us that free ether has an exceedingly small susceptivity for electrostatic and for magnetic action, but far smaller for the first than the second one.

Either of these facts, or both, are likely to be obscured in the other systems of measures. We now understand why therein, to equate to unity either of the fundamental constant, has resulted in a set of derived units of abnormal values.

The small values of κ_0 and λ_0 are justified, if we consider their relation with the velocity of propagation of ethereal disturbances. Indeed, these values satisfy the equation:

$$(\kappa_0 \lambda_0)^{-\frac{1}{2}} = 3 \times 10^8$$

In view of the definite physical signification attached to κ_0 and λ_0 in the rational system, the direct interpretation of this result is not difficult.

Thus, rational units of electromagnetism do not any longer afford a method for calculating π, but only the speed of light.

I have mentioned Prof. Fessenden's proposal for the suppression of 4π. My own proposal is grounded on Prof. Fessenden's one. It has a point common with it, that is to alter the traditional value unity of the ether inductivity, and to shift 4π within it.

But Prof. Fessenden's object is simply to get rid of 4π in the formulas; therefore he assumes $\lambda_0 = 4\pi$, and that is sufficient for his purpose. I develop his suggestion still further, and get a scheme which physically is to be interpreted otherwise.

I wish not only to get rid of the 4π, but of a greater evil—that is, the distinction between practical and absolute system of units. In my system λ_0 is not a numeric, nor do I assume any special value for it; it is a physical quantity, having dimensions, and to be measured by experiment. I assume as fundamental the volt and the ampere, as arbitrarily chosen units, and not derived from mechanical units. When I put them in connection with any special unity of length, then I get λ_0 in henries per meter or in henries per inch. Practically this results as follows:

1st. I frame the practical units into an absolute system, and all other absolute systems are abolished.

2d. The practical electrical units may be related to the inch, as well as to the meter, without destroying the absolute feature of the system. This is, I think, an advantage.

3d. The fundamental units of the electric system are not specific, but electric ones. Thus in future, the so-called absolute determinations of the ohm will be interpreted as measurements of the ether inductivity.

I am of the opinion that to start from concrete units and quantities and then to derive specific ones from them will greatly simplify the understanding of the theory to students.

[7] In the rationalized system, inductivity is substituted for "permeability." The latter word, after Mr. Heaviside, may be preserved in its former signification; that is, in the meaning of relative inductivity. Thus, inductivity and inductance are physical quantities, while permeability and permeance are pure numbers; the latter are sometimes useful to consider. The symbol μ ought to be continued in use for permeability and λ for inductivity. This avoids confusion between irrational and rational equations. Likewise I use F and f for rational magnetic and magnetomotive forces, while H and h are used for the irrational ones. The letter λ agrees with L, magnetic inductance, just as μ with K, electric inductance.

American Electrical Machinery for a British Steam Railway.

The last of the main generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse Works, at East Pittsburg. These generators are of the railway type (1,200-kw, 650-volts, 90 r. p. m.), and are to be direct connected to vertical, cross-compound, Westinghouse-Corliss engines of 1,500-hp each. The power-house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant comprising two compound-wound generators, each having a capacity of 200 kw at 650 volts, direct-connected to Westinghouse compound engines, and running at a speed of 250 r. p. m. The power generating plant will have an aggregate output of about 6,600 hp—6,000 hp for the railway proper, and 600 hp for lighting. The Westinghouse electro-pneumatic system of train control is to be used, and the cars will be equipped with Westinghouse high-speed air brakes. The rolling stock will consist of 60 cars, each about 60 feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor cars, equipped with four 100-hp motors each.

The Mersey Railway connects Liverpool and Birkenhead, and passes under the river Mersey. The tunnel is double tracked. The route of the railway is about four miles and a half long, the total length of track, including sidings, being about 12 miles long. Its situation is unique, joining two such important business cities, between which the only competition in the transportation of passengers and freight is given by ferry boats on the river, and the traffic on the line is large. The number of passengers carried amounted to between seven and eight millions per year, even with the old steam locomotive system.

The railway is standard gauge, laid in accordance with heavy steam railway practice, the rails being of the ordinary English "bull-head" type, weighing 86 lbs. per yard. The line is to be fitted with the third-rail system, the conductor rail to be laid alongside and just outside of the running track. The running rails will not be used as the return electrical conductor, but a fourth rail is to be placed between them, solely for this purpose. This will entirely prevent any destruction of the track rails or buried pipes in the vicinity by electrolytic action. The third and fourth rails will be similar in size and in arrangement. They are to be of T-section, 60 feet in length, and to weigh 100 lbs. per yard. They will be effectively bonded and carried on stoneware insulators, spaced at intervals of seven or eight feet apart.

It is expected that the trains will run on a three-minute service. The tunnel and the seven stations of the system are to be electrically lighted throughout. The power generating station, the machinery and the track work are all being pushed rapidly to completion.

Electric Light and Power at the Dusseldorf Industrial and Trades Exposition.

BY FRANK C. PERKINS.

The exhibits of steam driven pumps and electrically operated pumps at the Dusseldorf Industrial Exposition, now being held, are most extensive and interesting. The joint exhibit of Haniel & Lueg, of Dusseldorf-Grafenberg, and W. Lahmeyer & Co., of Frankfort-on-the-Main, is very complete and well worth consideration. This complete electric pumping plant consists of a generating station, which in practice is installed above ground and the pumping station situated underground. The former comprises an engine, built by Messrs. Haniel & Lueg of 1000 hp, operating a 750-kw Lahmeyer high-tension three-phase generator at a speed of 94 r. p. m. The latter comprises a slow speed Haniel & Lueg pump, coupled direct to a Lahmeyer three-phase motor of a capacity of 650 hp (Fig. 5).

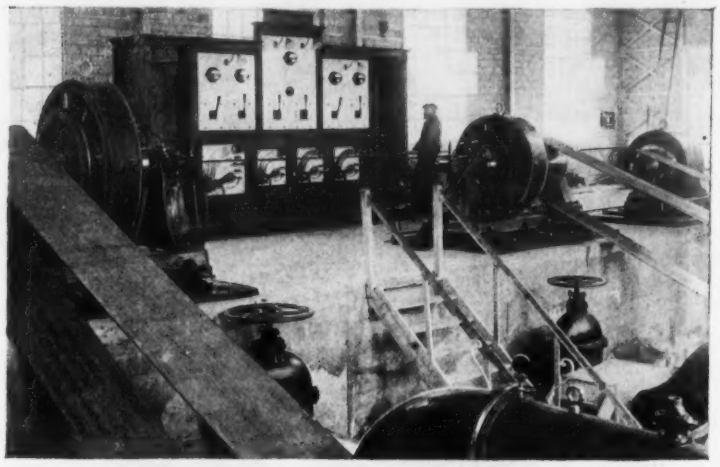


FIG. 1.—PUMPING STATION.

The 1000-hp unit of the generating plant consists of a horizontal cross-compound steam engine, whose high pressure cylinder has a diameter of 670 mm. and the low pressure cylinder a diameter of 1075 mm., the length of stroke being 1200 mm. and the engine speed 84 r. p. m. This engine is directly coupled to a 2000-volt Lahmeyer three-phase machine, which has a frequency of 50 alternations per second. The current from this generator operates a 650-hp three-phase motor, which drives the pump, having a capacity of 5.5 cubic meters of water per minute (1210 gal.) against a head of 450 meters (1485 ft.). The motor operates at a speed of 60 r. p. m. at a potential of 2,000 xolts, and a number of these slow speed motors have been used for pumping plants in the Rhine provinces and Westphalia with great satisfaction, and they have been found to fully stand up to the severe conditions imposed upon them by mining engineers in safety of running and economical working of these important plants.

There is also on exhibit by these joint firms an enclosed three-phase motor coupled to a centrifugal pump of 310-hp capacity when operating at 165 r. p. m. Two of these sets are to be used at the Imperial shipyards at Kiel for use at the drydocks.

In the exhibition of the Bergbauliche Verein one of the chief objects of interest is a large express pump of 440 hp capacity, built of Ehrherdt & Sehmer, of Schleifmuhle, which is directly driven by a Lahmeyer, 2000-volt three-phase motor. This motor operates at a speed of 346 r. p. m. and is started by a specially designed, liquid rheostat. The above manufacturers also are exhibiting an underground pump driven by a direct-current motor at a speed of 125 r. p. m. The motor has a capacity of 23 hp and the pump raises 2 cubic meters of water per minute under a head of 39 meters.

At the right hand side of the hall is shown an electric express pump of the Riedler type, having two simple acting plungers, each 185 mm. in diameter and a stroke of 250 mm. The electric motor is of the three-phase type and constructed by the Helios Electric Company of Cologne-Ehrenfeld. This motor has a capacity of 450 hp and operates at a speed of 200 r. p. m. at a potential of 2000 volts. Another important high power pumping plant is that exhibited by Haniel & Lueg in the Mines Building. This pumping engine has a capacity of 3600-4000 indicated hp, and supplies 25 cubic meters of water per minute under a head of 500 meters. The triple expansion steam engine cylinders are respectively 950 mm. 1500 mm. and 1650 mm. in diameter, while the length of stroke is 1700 mm. This great pumping engine has a

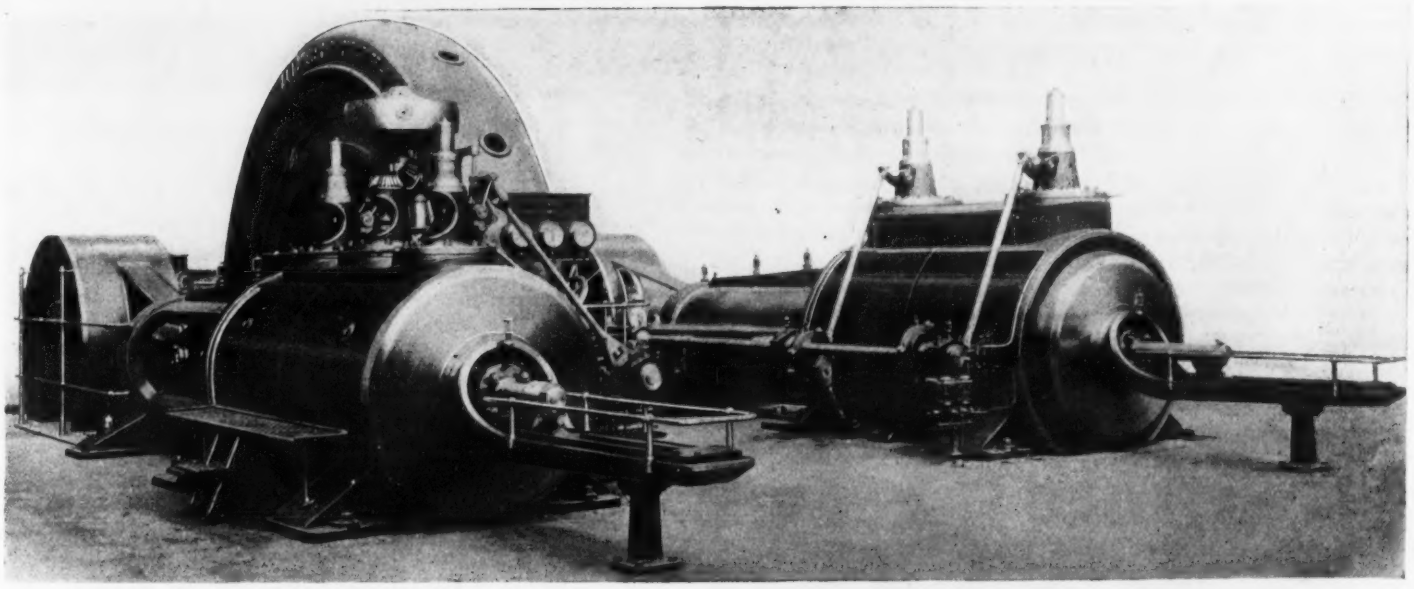


FIG. 2.—ELECTRIC GENERATING UNIT FOR ELECTRIC MINING PUMP PLANT, DUSSELDORF INDUSTRIAL EXHIBITION.

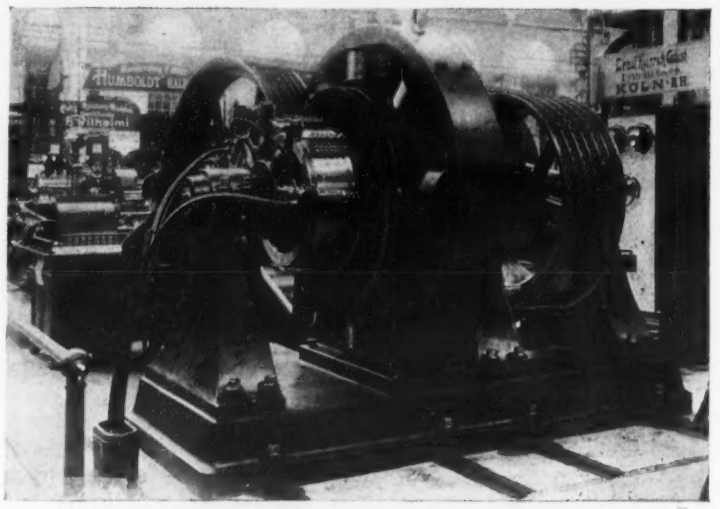


FIG. 3.—GENERATOR CONNECTED BY HEMP ROPE TO ENGINE.

speed of 60 r. p. m., at a rate of 3.4 meters per second. The total weight of the engine is 500,000 kilograms and it is in daily operation from 4½ to 6½ hours. Behind the steam cylinders lie the double plunger pumps, and directly back of these the air pump. This engine was constructed for the Harpener Bergbau-Aktien-Gesellschaft.

The firm of Ernst Heinrich Geist, of Cologne, also makes a large and most comprehensive exhibit. In Machinery Hall the firm show a 350-amp., 440-volt direct-current generator which has a speed of 300 r. p. m. It is connected by hemp ropes to a 225-hp Deitrich & Bracksieck steam engine. The shaft is supported by three bearings which are bolted to a foundation, which also supports the cast steel magnet frame which has an external diameter of 1790 mm. The eight pole pieces are also of cast steel, are circular in section, have the pole shoes cast on and are fastened to the frame by two bolts each. Each pole piece can be easily removed without taking the entire machine apart. The external diameter of the armature is 1150 mm. and it is of the drum type, being wound with machine formed bar coils, Fig. 3.

The switchboard consists of a rectangular framework which contains the resistances, fuses, switches and connections, so that the marble front of the board only shows the instruments, the switch handles and the regulator hand wheel. This machine, which works in parallel with a Lahmeyer machine of the same capacity, furnishes current for the lighting of the exposition.

The centrifugal pumps which furnish the water for the fountains and boilers are driven by four 440-volt direct current, Geist motors of 120, 80 and two of 55-hp, situated in the pumping station. These motors are built on the same general lines as the generator in the machinery building. The two 55-hp motors, however, only have two bearings, cast iron magnet frame, with cast steel pole pieces and wire armature coils. All four motors are controlled from one central point. For this purpose, a raised switchboard has been erected along the one wall of the building which contains all instruments, switches, rheostats, etc. Only the instruments, hand wheels and switch handles are visible in front of the board, Fig. 1.

In the buildings of the Mining Association of Dortmund, a 55-hp direct current Geist motor has been installed for driving an express pump of the firm of Klein, Schanzlin and Becker, which

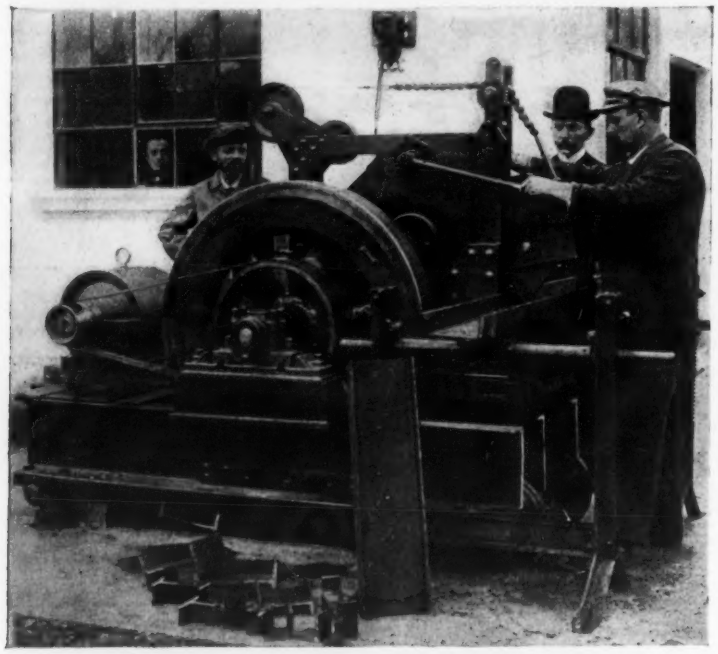


FIG. 4.—PORTABLE CUTTER FOR STRUCTURAL IRON.

is of the slow speed shunt type, built after the pattern of the 120-hp motor in the pumping station for speed of 220 r. p. m. This made it possible to connect the armature direct to the crank shaft of the pump. This method avoids many frictional losses incident to other modes of transmission and gives the combined unit a high efficiency. The armature coils are of wire and the motor has only one bearing at the collector end, as the pump bearing is used at the other.

Another 12.5-hp motor drives a compressor made by the firm of Stahl & Eissen. The motor and the starting box are mounted directly on the cylinder wall of the compressor, so that no extra foundation and room are necessary for the electrical equipment.

Of special interest is the illumination of the Association buildings, which are lighted by 3500 16-cp incandescent and 28 arc lamps. The object of the illumination is to bring out the archi-

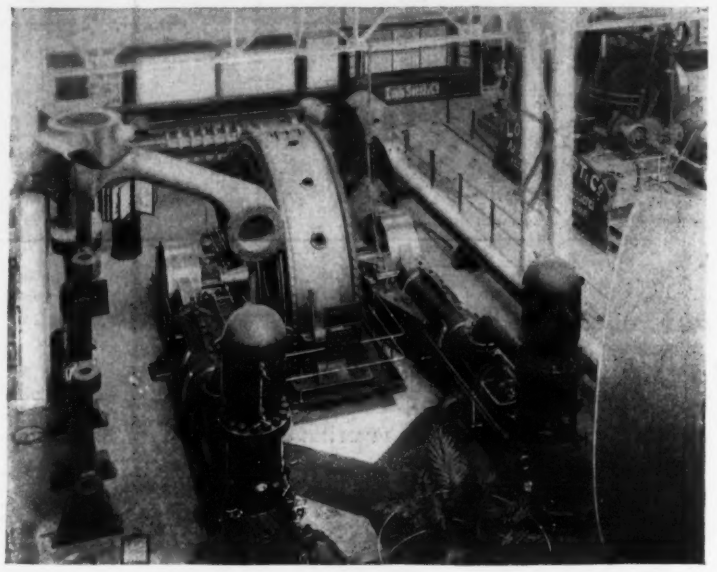


FIG. 5.—650-HP LAHMEYER THREE-PHASE MOTOR.

tectural beauties of the buildings at night and for this purpose the lamps are placed at 50 cm. distances along the edges of the buildings.

In order to insure at once a simple, cheap and easily controlled arrangement, on the 2x220-volt circuit, groups containing about 20 lamps are connected in series. In this manner 110-volt lamps could be used and in case one lamp burns out the neighboring lamp is not affected, as is usually the case. It is true that the e. m. f. in the other group is raised a trifle, but the lamps only become imperceptibly brighter. The arc lamps illuminate the windows, four 12-amp. lamps being connected in series, so as to use the entire pressure. The lamps may be pulled down for trimming by means of cords and pulleys, but contact couplings are provided, so as to avoid the unsightly appearance of the leads and have the additional advantage of having the current cut off when the lamp is being trimmed, so that accidents are almost impossible.

In addition to the motors and installation described above, the firm exhibits a number of other interesting machines, including a three-phase motor, with short circuited armature, 5-hp, 110 volts, 1500 r. p. m. for operating a portable, structural iron cutter, built by Pels & Co., Fig. 4. There are also two three-phase 1-hp motors, 1500 r. p. m., for operating American dish-washing machines, and two direct current motors, 0.5-hp, 220 volts, 1000 r. p. m., also for operating American dish-washing machines in the Exposition restaurant. Various automobile motors are shown operating the vehicles of Heinrich Scheele.

"Pioneer Patents."

At the annual meeting of the American Bar Association, which was held at Saratoga last week, Mr. L. L. Bond, for the patent section, read a paper in which he said: "In the year no pioneer patents have been issued, and I use the word 'pioneer' in its usual acceptance, to wit, that of an invention which strikes out a new art or a new industry. A large number of patents have been issued, but almost entirely improvement patents, which are sometimes called 'perfection patents,' which, while they are important, do not produce new machines. There have been no leading decisions, such as will stand out as landmarks in the way of interpreting the law. Patent litigation in many circuits has fallen off materially."

The Electrical Industries of Russia.

A very interesting and comprehensive report on the subject of the development of electrical industry in Russia has been made to the U. S. State Department by Mr. Thos. E. Heenan, U. S. Consul at Odessa, South Russia. We present, very fully, below its leading points:

Until recent times, the electric industry has made extremely slow progress in Russia. Unfavorable circumstances have combined to impede the industry and prevent it from reaching the level found in other countries. One of the principal causes of this lack of development was the absence of schools in which to educate electricians. Foreign engineers and specialists prefer to have recourse to materials and apparatus made abroad, of which they know the value, rather than to try to build factories and works in Russia for the production of the articles required by them. Of late, however, the government, private companies and individuals have opened special schools for electricians; and, in addition, the special art and artisan schools have introduced an electro-technical course. The influence of these special schools and courses has not been slow to make itself felt, and of recent years electric industry has made immense progress. Many towns and cities are lighted by electricity, and electric tramways are numerous. Nearly all of the large factories and industrial establishments have adopted electric lighting and have applied electricity to the distribution of motive power. Electric energy has also been utilized in mining enterprises, particularly in the south of Russia. The use of electricity in soldering, in the extraction and refining of metals, as well as in certain electro-chemical works, and in the production of carbons and hypochlorites, is now well developed in Russia. With the increased and varied applications, the demand for apparatus has grown enormously, and dynamo machines, motors, transformers, lamps, conductors, etc., find a large sale. In response to this demand, workshops and factories have been established which produce more particularly the accessory supplies and conductors. There are but two factories in Russia which produce dynamo machinery and lamps, and in consequence most of these are imported. Germany and Switzerland furnish the largest number; next comes England, and then follow the United States, France and Belguim. Statistics on the subject are not obtainable at the present time.

ELECTRIC LIGHTS.

A few years only have passed since such cities as St. Petersburg and Moscow began to have their streets lighted by electricity. At present there are more than 50 towns which employ the electric light, and many other places are erecting the necessary apparatus. The rapidity with which the use of electricity has spread at St. Petersburg will serve as an example of the popularity of this manner of lighting. The first central station was installed in the city in 1881. The power of that station was about 250 kw. Until 1885 the power increased very slowly. After that year the power of the stations and their number grew rapidly, and in 1898 there were several plants, having together 29,000 kw. In 1898 and 1899 three additional central stations were constructed in St. Petersburg, and at the present time the power of all the central stations taken together (exclusive of the private plants) reaches 15,000 kw. Work near completion will raise the power at these stations to 30,000 kw. The number of isolated plants is about 300, and these have a total power of more than 39,000 kw. St. Petersburg is lighted by means of arc lamps on the principal streets and by incandescent lamps on ways of less importance. In addition to the arc lamps on the streets, there are about 300 street lamps fed from private plants. Motors, having a power of about 4,500 kw, have been installed. In many of the private plants storage batteries have been put up, and their capacity exceeds 50,000 amp.-hours. The number of dynamo machines erected is over 500. As a rule the current in the consumption circuits is continuous. Steam engines for driving the dynamos are principally employed, but gas motors and petroleum motors are also in use.

All of the large stations work with alternating currents, and one of them uses three-phase current. The greater part of the network is underground, and consists of armored cables. Aerial conductors are not in use except at a few stations. The aggregate length of the network is over 625 miles. The tension of the current in this network is from 2,000 to 3,000 volts.

In Moscow and in other towns, both large and small (particularly those situated in the industrial region), the use of electricity has made no less rapid progress than in St. Petersburg. In the begining, the stations constructed were almost all for the continuous current, but in the later ones the preference was for the single-phase and three-phase alternating current. The network is sometimes underground and sometimes overhead.

ELECTRIC TRACTION.

Electricity is also coming largely into use for trolley roads. The first electric tramway built in Russia was the one at Kief, which dates from 1893. In 1898, 45 cities had constructed such lines, their length exceeded 312 miles, and nearly 10,000 kw were in use for the motors. The number of motor cars was then about 300, and there were many trailers. The total length of wire for the electric tramways in St. Petersburg is estimated at 1,875 miles. Aerial conductors and underground conductors will be used, and, on the principal streets, accumulator traction. Nearly 400 motor cars will be in use, and 300 trailers. Other cities also contemplate the employment of electricity on a large scale, and plans are under consideration for its use on the great railroads of Russia. These projects include the construction of an electric railroad to connect neighboring towns on the western frontier of Russia, and the establishment of a road to cross the Caucasus Mountains, between the town of Suhkum and one of the stations of the Vladikavkas Railway. For this latter road it is proposed to utilize the water power of the mountain streams. Electric traction is already in use on the railroads serving large factories, in the mining industry, and in other enterprises.

ELECTRIC POWER.

The use of electricity for the distribution of motive power is spreading, and to-day all of the machine works of Russia have adopted this method. Enormous central stations for power purposes have been erected at places where such factories exist; for instance, at the Kolomna machine shops, at the works of the Sormovo Association, at the Putilov works, and many others. All of the larger elevators on the Vladikavkas Railway and on the Moscow-Kazan Railway are operated by electric motors. Up to the present, electricity has scarcely been used at all for the transmission of energy for great distances. Projects, however, are under way to utilize the waterfalls of Marva and Imatra. The Russian Government has granted a concession to a company to supply power to St. Petersburg from the Volhov Rapids. The estimated cost of the enterprise is about $14,000,000. It is said that the power to be transmitted will equal 150,000 kw, and the maximum transmission distance is 188 miles. The company has undertaken to provide the public lighting of St. Petersburg gratuitously, and hopes to furnish current to individuals at about half the price hitherto charged. The engineer of the scheme is a Russian named M. Dobrotvorsky. It is also intended to use the enormous power of the Dnieper Cataracts for the transmission of energy.

ELECTRO-CHEMICAL INDUSTRY.

The progress of the electro-chemical industry and of electro-metallurgy is interwoven with the utilization of hydraulic force as motive power. There are now several establishments which obtain copper and refine metal by the electrolytic process. Such establishments exist in the Ural and the Caucasus, and have an output that is important. Thus, the works of Siemens Brothers, at Kedabeg, in the Caucasus, annually produce some 500 tons of copper. Many less important works in St. Petersburg, Moscow, Nizhni Novgorod, etc., utilize steam power for the refining of copper and impure copper waste by the electrolytic process. Some of these works obtain as by-products of the electrolytic process other metals, such as lead, antimony, etc. There are as yet very few special electro-chemical works in Russia; one factory near the Imatra rapids produces carbide of calcium, and other works for a similar purpose also exist. A large electro-chemical factory has been erected in the government of Kharkof, for the production of caustic soda. Electric soldering is in use in metallurgical and mechanical works, and also in the railway shops; this is accomplished with the aid of the voltaic arc, a Russian invention.

ELECTRIC APPLIANCES AND MACHINES.

It will be seen that the application of electricity has advanced in Russia, and that electro-technical appliances will have a great future

there. Russian factories cannot supply the demand, and the deficiency is made up by foreign firms which have their representatives there. Russian manufacturers produce many cables and insulated wires. At St. Petersburg and Moscow, there are a number of factories in this line, and their output compares favorably with the foreign articles. The most important of these establishments are the Siemens and the Riben, both of which produce cables of the most satisfactory character. Nevertheless, cables in large quantities are imported from abroad, the home manufacturers not being able to supply the market. Accumulators are also manufactured in various towns in Russia. There are a number of establishments in St. Petersburg which produce accumulators of original design, or after the best-known foreign models, such as the Julien, the Tudor and others; and the importation is small. Such appliances as circuit breakers, commutators, rheostats, etc., are also manufactured in Russia, but not nearly enough to supply the demand. Measuring instruments are scarcely manufactured at all, although the demand for them is enormous, especially of late, since central stations have been constructed in a number of towns. These instruments are imported from France and Germany. The manufacture of porcelain insulators and of porcelain appurtenances in general is so largely developed in Russia as to completely satisfy the home demand, and no insulators are imported. Incandescent lamps are not manufactured in Russia at present; an establishment formerly existed for the manufacture of these lamps, but foreign competition was so strong that the attempt was abandoned. The lamps are at present imported from Germany, France, England, Austria and Sweden. Arc lamps are produced in limited quantities, and the greater number of those used are imported from Germany. Carbons for arc lamps are also manufactured in Russia, though most of them come from abroad.

As regards dynamos, motors and transformers, they are manufactured by only one firm—Siemens & Halske, at St. Petersburg. This house makes annually dynamo machines and motors of which the aggregate strength is about 6,000 kw. It is also the only firm in Russia which produces appliances required in electric traction.

One branch of the electro-technical industry is fully supplied by the home manufacturers, and that is the signalling and telegraphic apparatus in use on the railways. As regards telegraphic appliances proper, some are manufactured in Russia and some come from abroad, chiefly from Sweden and Germany.

HOW TO EXTEND UNITED STATES TRADE.

It will thus be seen that the demand for electro-technical apparatus and machines in Russia is relatively but little satisfied by the home manufacturers, and the progress in the application of electricity for transportation, manufacturing and domestic economy will undoubtedly enormously increase the market for foreign appliances. American manufacturers should have their share of this trade, and there is but one way to secure it—that is, to establish branch houses in this country and place the same in the hands of competent men. The Germans hold the field in supplying this country with electric appliances, because they are ever present and always patient; they study their customers, ascertain their financial condition, give long credit with reasonable interest, and employ men who are either German-speaking Russians or Germans born in Russia, who, of course, speak both Russian and German.

It will require more than a casual visit to Russia on the part of our business men, if we are to win our proper share of the future business to be done in electrical appliances. It is not too much to say that in no other branch of trade is there likely to be such material progress in Russia.

A Faustian Draught.

A Long Island newspaper had the following item recently: "Last Sunday as that heavy storm swept over Queens Borough, a bolt of lightning struck a tree in Fuehrer's Jackson Avenue Park, running down same and all around a keg of beer and around a glass of beer in the hands of a thirsty waiter, and exploded with a loud report as it buried itself in the ground. The glass of beer remained intact, and nobody can drink the same, for as soon as the lips touch the beverage, a shock is felt. The same is on exhibition at Fuehrer's, and must be seen to be appreciated."

German Electrical Manufacturing Conditions.

The U. S. Consul General at Berlin, Mr. Frank H. Mason, has sent to the State Department an interesting report on present conditions among German electrical manufacturers. We give his discussion of the subject herewith:

What is called in headlines by the German press "The catastrophe in the Schuckert Electrical Company," has recalled public attention sharply to the conditions under which some of the great electrical corporations of Germany were promoted, and the embarrassments which some of the methods employed have more or less inevitably entailed. The event alluded to was a meeting on July 26th of the stockholders of the Schuckert Electrical Company at Nuremberg, at which the managers announced that, through depreciation of plant and material, insolvent accounts, and necessary appropriations for a reserve fund to meet further depreciations, the company had suffered losses aggregating 15,500,000 marks, or something more than $3,500,000. As the Schuckert Company is one of the foremost corporations of its class in Europe, with an up-to-date plant and all the accompaniments of a large business, some surprise has been expressed that its affairs should make such a bad showing for its shareholders. The explanation leads back to the fact, now well known here, that the sudden rise of some of the German electrical companies into corporations of vast resources and activities was, in some cases at least, the result of skilful and artificial creation of markets for products, rather than the supply of an actual and legitimate demand. Concisely stated, some of these companies bought their orders for electrical installations and materials by financial operations that left them shareholders in many enterprises which have since proven less promptly lucrative than had been hoped, and have thus drawn more or less heavily upon the capital of the parent companies.

To understand how all this came about, it should be remembered that German progress in electrical science was for a long time far in advance of popular appreciation of its advantages. The companies organized and equipped for the manufacture of lighting and power plants could not wait for the slow growth of public demand for such improvements, and they therefore undertook to finance and erect such installations themselves, confident that, once established and in use, the public would not fail to appreciate them and invest in their securities. This went very well for a time. It created a large and ready market for electrical machinery and materials at high prices, and supplied hesitating municipalities with electric tramways and lighting plants which their citizens greatly enjoyed, but which were built and for a time managed by the electrical manufacturing companies at their own expense. Inevitably, this process of consuming their own capital necessitated heavy loans and frequent increases in the stock of such corporations, together with a steady expansion of their manufacturing capacity. Some of the companies, especially the Schuckert, made enormous investments in electric installations for the manufacture of calcium carbide, putting in the machinery at their own prices, but receiving for it little or nothing except stock in the carbide plants. Thus the supply of acetylene material was soon far beyond all legitimate requirements, prices collapsed, and the carbide industry suffered a serious and permanent reverse.

Another heavy blow for some of the German electrical manufacturing companies has been the failure of storage-battery traction for tramways. When electric traction was introduced into this country, municipal governments were timid and hesitating. They objected to the overhead conductor because it was considered unsightly and dangerous, and in order to obtain any franchise at all the tramway companies and the electrical manufacturers who were behind them had to agree to furnish cars that would dispense with a visible trolley. This meant either the underground-conduit system—which is so expensive to construct as to be justified only by an enormous traffic—or a reliance upon storage batteries, and the companies generally had recourse to the latter. The extent to which this has been done may be inferred from the fact that one company in Hanover has at present 274 accumulator cars in service. There, as at Halle, Hagen, and many other places, they have been found so heavy and costly as to be unremunerative. At Berlin, where many hundreds of them have been in service, all are to be aban-

doned and recourse had to underground conductors for centrally located streets and overhead wires for the less crowded and suburban sections.

The net result of all these conditions was that some of the electrical manufacturing companies of Germany, which had gone on organizing and supplying power, lighting, carbide, and other plants, not only at home but in Russia, Scandinavia, Austria-Hungary, and other European countries, were caught with all sail spread by the turning tide and adverse gale that set in during the summer of 1900. In the stormy weather that ensued, most industrial stocks declined sharply, the investing public became alarmed and timid, the failures of the Leipziger and other banks followed a few months later, and led on to the situation of which the meeting of last week at Nuremberg has been the ultimate result.

The encouraging features of the present condition are the fact that the credit of several of the oldest and strongest of the electrical companies remains unshaken, the general feeling that the bottom has been reached, that the obligations entailed by a system of forced development have been mostly liquidated, and that with the good cereal crops that will be harvested this year, peace throughout the world and the hoped-for renewal of the commercial treaties which are to lapse next year, the foundation will be laid for a renewed and enduring prosperity.

Calcium Carbide Manufacture in Italy.

BY CESARE PIO.

IN Italy the industry of calcium carbide production is rapidly progressing, and the number of furnaces operated with direct or polyphase current is increasing every day. The number of patents applied for apparatus, devices, etc., relating to improvements of this industry is rapidly growing. At the beginning of this industry, a great number of ignorant people put on the market faulty apparatus, cheaply built, to make acetylene gas, and called gasogenes. This produced so many accidents and explosions that the industry of calcium carbide suffered a very bad setback, and it is only since last year that business in this line in Italy has become profitable. After the construction of the factory of Pont Saint Martin, near Ivrea (Piedmont), which utilizes water power, many other companies were formed and electric furnaces were installed where it was possible to obtain power from waterfalls. In 1897 the Società Italiana del Forni Elettrici, of Rome, installed a factory at Narny. A little latter, the Società Italina del Carburo di Calcio, capitalized at 3,000,000 francs, installed a 3,000-hp plant near the Marmore Falls (Terni). In the month of August of the same year a company was formed in Turin, and electric furnaces were installed in S. Marcello d'Aosta, in the northwest of Italy, where the water power of the Dora Baltea River was utilized. This last plant, which is one of the most interesting of its kind, just now has been enlarged in view of the increasing demand for carbide.

The author, in ELECTRICAL WORLD AND ENGINEER, August 5, 1899, gave an account of this plant in an article on three-phase currents in the manufacture of calcium carbide in Italy. A great field open now to the industry of calcium carbide in Italy is in its application on the railroads, to the trains. A few years ago the use of acetylene was limited to small villages, but at present the number of big centers lighted with this modern system is continually increasing, and the applications of acetylene have increased since it was discovered that this gas mixed with a certain quantity of acetone may be easily transported without danger of explosion. Another field of application is the gas engine for small industries. This class of motor has not yet been satisfactorily improved, and industrial people in Italy are not very fond of testing new types of motors at their own expense.

The price of calcium carbide has been lately raised to 437.50 francs per ton, as against a price of 250 francs per ton last year. This seems to be the result of a syndicate recently constituted on the Continent, which is trying to keep up the price of this product. In a recent paper Mr. Riccardo Memmo, who is an authority in all questions regarding the manufacture of calcium carbide, discusses the conditions of this industry in Italy. According to his opinion, in order to render really remunerative the industry in Italy, the conditions to be met are as follows:

1. The price of the plant per horse-power installed, including machinery, furnaces and all the necessary supplies, must be not higher than 500 francs.

2. A certain ratio between the number of tons of carbide produced, and the number of effective horse-power produced must exist. The price of calcium carbide, including general expenses, must be not more than 120 francs per ton.

3. The capital expended must be liquidated in ten years. This corresponds to a sinking fund of 40 francs per ton produced.

4. The selling price of the carbide must be 250 francs per ton, so that, including freight, loss, profits, etc., the price to consumer must not exceed 300 francs per ton. On the capital invested at least 6 per cent. must be paid.

These conditions are not entirely fulfilled at present in the majority of existing plants, but with the continual development which is taking place in this industry in Italy, and also in consideration of the great amount of water power to be utilized, not only can these conditions be fulfilled, but the cost will be still further reduced.

Coronation Illuminations in South Africa.

The coronation of King Edward of England was celebrated everywhere throughout the British Empire with rejoicing and illuminations, and in the latter the use of electricity was large and striking, London itself affording perhaps the best example of old-fashioned sticking to gas for such purposes. In the colonies, particularly in Canada, the electrical effects were superb. We are now able, through the courtesy of Mr. A. W. Peirce, of

AMERICAN ARCH, JOHANNESBURG, SOUTH AFRICA.

Germiston, Transvaal, to give an idea of what was done in South Africa. In this part of the King's dominions, the rejoicings were intensified by the coming of long deferred peace and were probably all the heartier.

The arch which is herewith shown illuminated, was erected by the American residents on the Rand and at Johannesberg, Transvaal, on the south side of Market Square, and was known as the American Arch. Press and popular comments on it were most enthusiastic. The illumination was effected by no fewer than 1,300 incandescent lights, and ceurrent was furnished from Brakspan, no less that 25 miles away. The American subscribere were greatly gratified at the reception accorded their efforts, and at their ability thus to mark the enduring and cordial friendship between the empire and the republic in a country where the citizens of the latter had been able to do so much good work for its development alike in war and in peace.

Underground Work for Telephone Exchanges—II.

By Arthur V. Abbott, C. E.

DUCT MATERIAL.

THE bulks of duct material now on the market, certainly all that is worthy of serious consideration by the telephone engineer, will fall into one of the following four classes:

1. Wood ducts.
2. Cement ducts.
3. Vitrified clay ducts.
4. Asphalted or bituminized wood-pulp ducts.

FIRST—WOOD DUCTS.

This was the earliest of the duct materials used, and at its first appearance took the form of a wooden box about 8 ft. long, made of 1¼-in. creosoted yello wpine or similar wood. As is indicated in Fig. 1,

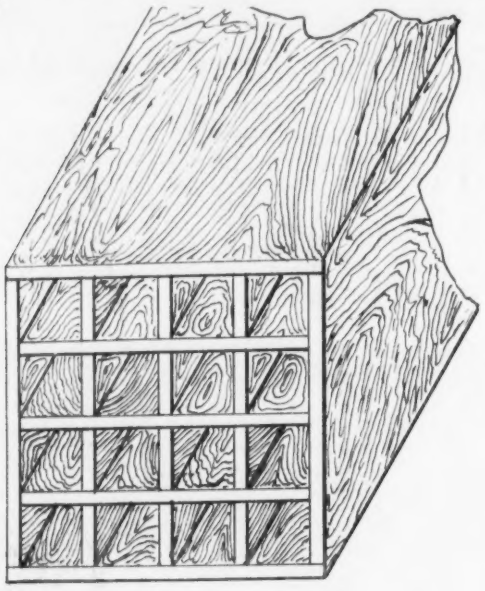


FIG. 1.—BOX CONDUIT.

it was easy to build the box in any convenient length and to construct as many diffierent ducts as the design of the conduit required.

A little later the familiar pump log in its round or square form, as illustrated in Figs. 2 and 3, displaced the box as being mechanically much stronger, cheaper to build by machinery, more flexible as to the number of ducts, and slightly less expensive to lay—particularly when a large capacity was contemplated. The Valentine duct and its congeners is illustrated in Fig. 4. This duct material consists of wooden slabs carrying a series of semi-circular curves, which may be piling the slabs on top of each other, a subway of any desired duct made of any desired size, or any number placed in each slab, and any capacity is easily constructed. In Table 6 will be found the dimensions of the wood work for conduits of this style, containing varying number of ducts of various sizes:

TABLE 6.

VALENTINE DUCT MATERIAL.

Sizes of Conduit.

	Inches.
1½-in. Conduit.	
Conduit containing 1 ducts, dimensions	3 x 3
" " 2 " "	3 x 5¼
" " 3 " "	3 x 7½
" " 4 " "	5¼ x 5¼
" " 6 " "	5¼ x 7½
" " 9 " "	7½ x 7½
" " 12 " "	7½ x 9¾
2-in. Conduit.	
Conduti containing 1 ducts, dimensions	3½ x 3½
" " 2 " "	3½ x 6¼
" " 3 " "	3½ x 9
" " 4 " "	6¼ x 6¼
" " 6 " "	6¼ x 9
" " 9 " "	9 x 9
" " 12 " "	9 x 11¾
2½-in. Conduit.	
Conduit containing 1 ducts, dimensions	4 x 4½
" " 2 " "	4½ x 7¾
" " 3 " "	4½ x 11
" " 4 " "	7¾ x 7¾
" " 6 " "	8 x 11
" " 9 " "	11 x 11½
" " 12 " "	11 x 15
3-in. Conduit.	
Conduit containing 1 ducts, dimensions	5 x 5
" " 2 " "	5 x 8¾
" " 3 " "	5 x 12½
" " 4 " "	8¾ x 8¾
" " 6 " "	8¾ x 12
" " 9 " "	12½ x 12½
" " 12 " "	12½ x 16¼

The street construction involved in laying wooden ducts is exceedingly simple. A trench of sufficient size to accommodate the requisite number of ducts is excavated, and the bottom carefully leveled. A very desirable, though not essential addition, is a bottom layer of plank, as shown in Fig. 5; or, better still, a stratum of three inches of clean sharp sand or gravel that may serve both as a bed for the timber and as a sub-drain to carry away any ground water that may subsequently accumulate. In particularly wet localities the sand, or even a line of open drain tile, may not only be desirable but necessary. When the bed is prepared, the first layer of wood is placed thereon, and gently—to avoid splitting—rammed to a good bearing. When the single duct or pump log forms, illustrated in Figs. 2 and 4 are used, the male ends of each piece should be dipped into hot pitch or tar, then driven firmly home into the female sockets of the preceding ones. In the Valentine or other similar form there is either a piece of felt or a kind of dovetail to be covered with hot tar and inserted between the outside joints of each slab. It is also well to place a piece of tarred paper or roofing felt around each joint and tack the same in place with wood battens. Protection from foreign picks is afforded by placing on the top, and preferably on each

FIG. 2.—ROUND PUMP LOG.

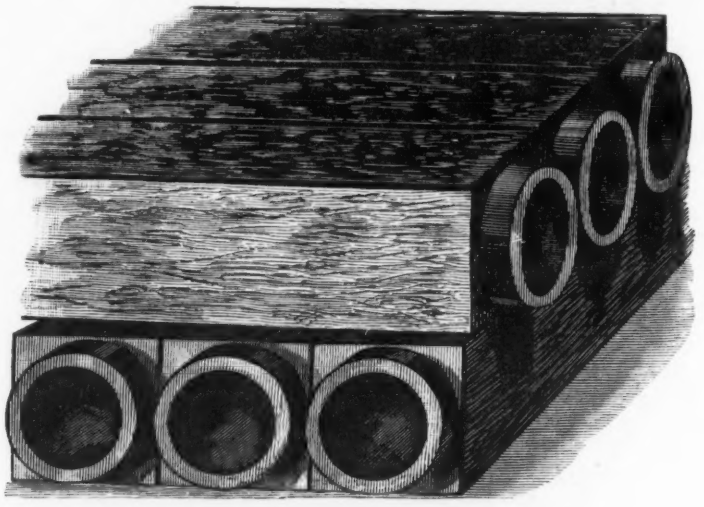


FIG. 3.—SQUARE PUMP LOG.

side, a 1½-in. or 2-in. plank. A layer of sand on the top and sides also adds materially towards keeping the conduit dry. In the single duct conduit curves of reasonable radius are easily made with the natural spring of the timber and its joints. With the Valentine, curves are accomplished by cutting the timber into short lengths and mitering the joints. As fast as the duct material is placed, the trench may be refilled and temporary paving placed. To lay the single duct wood conduit requires no skilled labor other than that of a vigilant foreman, while in the Valentine, one carpenter to cut and place the battens and miter for curves will keep a large gang busily employed.

It is hardly necessary to call attention to the necessity of treating the timber with some form of preservative, as otherwise decay—when

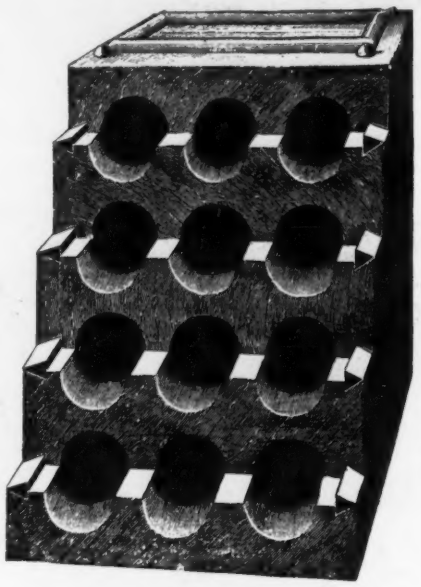


FIG. 4.—VALENTINE CONDUIT.

buried in the street—becomes exceedingly rapid. Probably the consensus of opinion is in favor of creosoting; but this or any preserving process, to be of value, must be carried out with exceeding care and thoroughness. As far as possible all forming and cutting should be done prior to treatment, as it is natural to expect the surfaces of the wood to be the most thoroughly impregnated.

In creosoting, the first operation is that of steaming, which is accomplished by treating the wood in a closed retort for from two to three hours, with steam pressure of from 25 to 50 lbs. The air pump is then applied and a vacuum of at least 20-in. maintained in the retort so long as there is any flow of sap from the timber. The retort is then pumped full of dead oil of tar, and the whole subjected to an hydrostatic pressure of at least one hundred pounds to the square inch. Most scrupulous care must be exercised to see that pure dead oil of tar is employed for impregnation, otherwise the destruction of the cable sheath is simply a question of time. A chemical analysis of the oil used should be required. In order to secure the desired amount of impregnation, the hydrostatic pressure should be main-

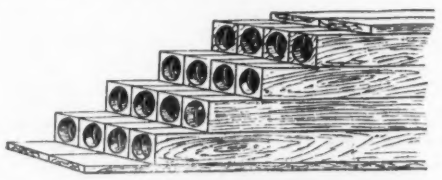


FIG. 5.—FOUNDATION FOR VALENTINE CONDUIT.

tained for at least three hours, and, finally, no timber should be accepted that does not show an absorption of at least 14 lbs. of oil per cubic foot.

After creosoting, the ducts should be allowed to season in the air for some time, two or three months if possible, in order to dispel any possible remains of phenol in the oil, for in the early use of creosoted wood considerable difficulty was experienced with the formation of lead carbonate and the consequent perforation of the cable sheath and the destruction of the cable. So much difficulty was experienced from this source that the use of creosoted wood for conduit purposes was practically condemned. Further experience, however, proved that if pure dead oil of tar was used, and the ducts after treating were thoroughly seasoned, no apprehension need be entertained from any corrosive action upon the cable sheath. Creosoted wood ducts possess the advantage of cheapness, ease of handling, rapidity of construction, flexibility, facility in distribution, for from any duct a wire may be taken by the simple process of opening the street and boring a hole in the side of the conduit. Per contra, they are by no means moisture or gas proof, have only medium insulating qualities and are in no wise indestructible—being credited with a probable life of about 15 years, and are not completely free from the suspicion of originating injury to the cable sheath. For these reasons creosoted wood finds its place in the conduit systems of small towns, and in the laterals and subsidiary ducts of rapidly growing portions of cities where great economy of installation and short probable life of the conduit are likely, but for the main lines and heavy leads of the permanent subway of important cities some of the other and more permanent forms of ducts are preferable.

A New German System of Electric Train Lighting.

The subject of train lighting has of late been even more agitated in Germany than in this country, owing to serious disasters in fires on wrecked trains, due to other illuminants than electricity; and the result is that the thoughts of inventors and manufacturers have been turned in the direction of electric train lighting. One of the latest and most prominent systems now being tried in Germany is that of Mr. Otto Böhm, whose apparatus has been running on a train in Germany, when reports reached us, for 90 days without a single interruption, it is said, making 224 km. per day, or a total of about 12,600 English miles, up to date. Several other equipments are now under trial in Germany and Russia.

The system in question is adapted to the lighting of whole trains as well as single carriages, and belongs to the category in which current for the lamps and batteries is furnished by a dynamo carried upon and driven by the car-axle. When the train is not in motion, current is supplied to the lamps from the battery; this is also the case when the train is in motion, but running below a certain critical speed.

The objections to driving a dynamo from the axle are usually of a practical nature, inasmuch as the machine is exposed to dust, constant vibration and frequent shocks. Whatever arrangements are

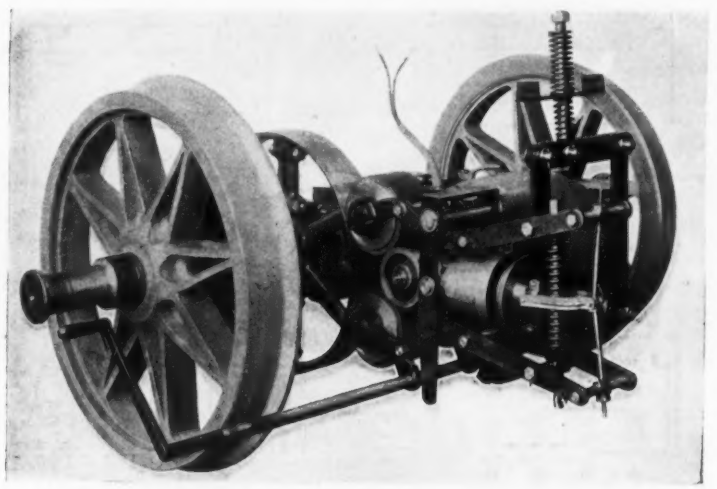


FIG. 1.—FRICTION GEAR.

made for transmitting the power from the axle of the car to the dynamo are, therefore, bound to satisfy first of all the requirements of a very rough service. The Böhm arrangement is simple enough, it is claimed, to meet these practical requirements of the service, and still so delicate as to maintain a practically constant voltage at the terminals, irrespective of the speed of the car within a wide range.

A most favorable element in the system is the fact that during that part of the day when the dynamo is not required to furnish current, it is placed entirely out of connection with the axle by the movement of the lever *L* (Fig. 2). This lever is operated by an ordinary train-

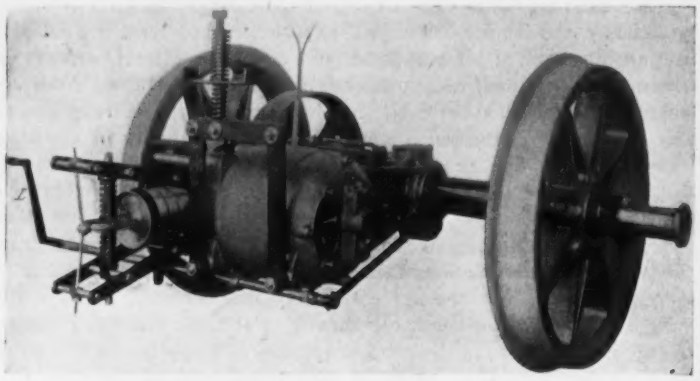


FIG. 2.—ANOTHER VIEW OF FRICTION GEAR.

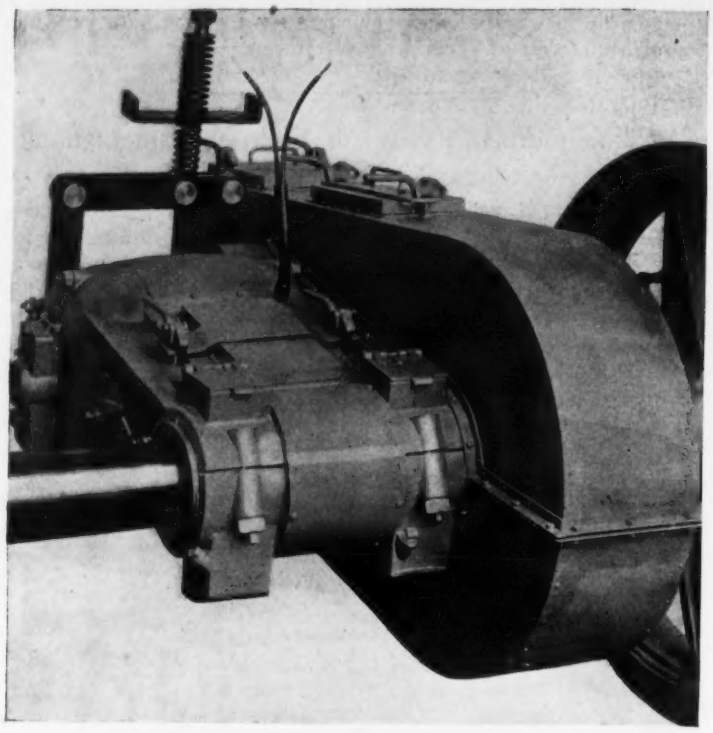


FIG. 3.—DYNAMO AND GEARING ENCASED.

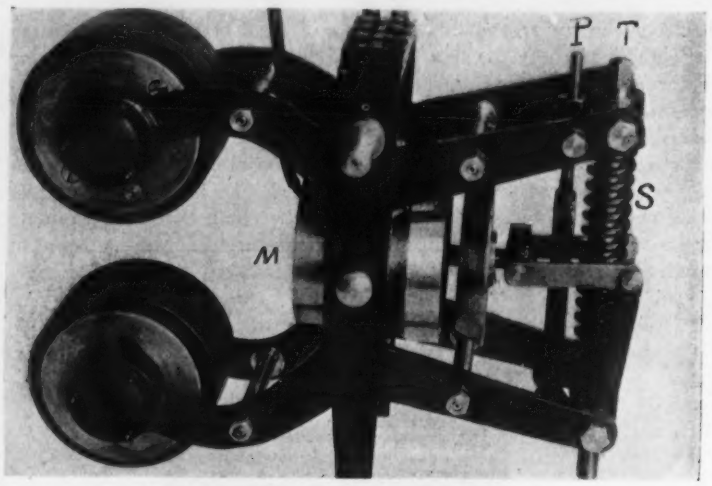


FIG. 4.—FRICTION WHEELS.

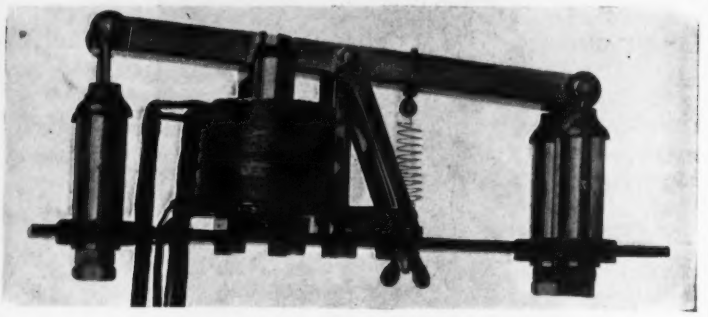


FIG. 5.—AUTOMATIC CUT-OUT.

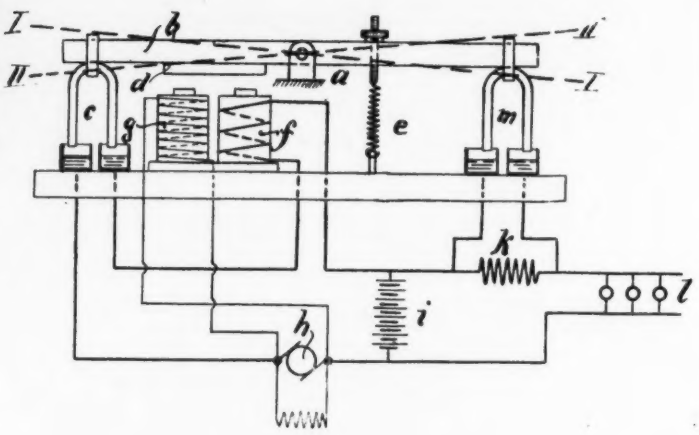


FIG. 6.—DIAGRAM OF AUTOMATIC CUT-OUT.

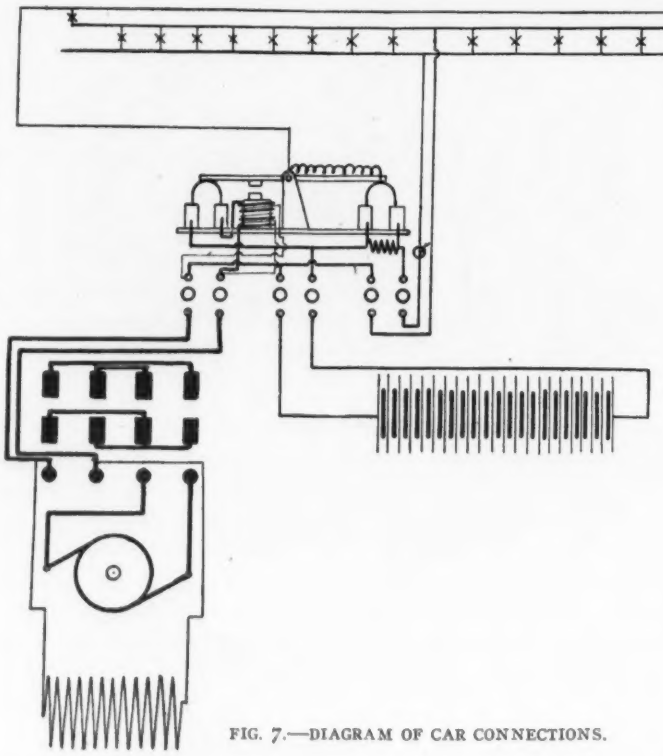


FIG. 7.—DIAGRAM OF CAR CONNECTIONS.

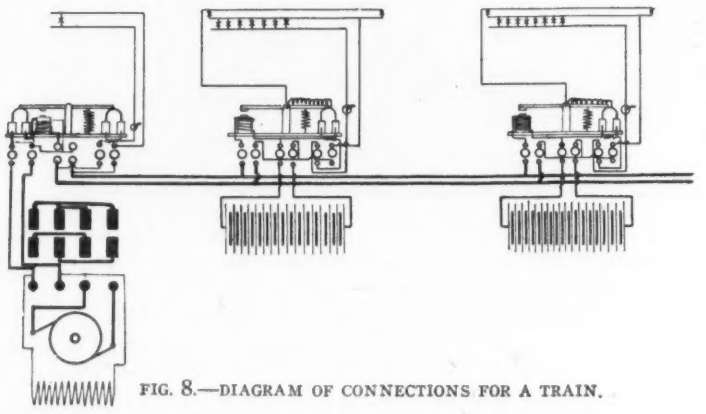


FIG. 8.—DIAGRAM OF CONNECTIONS FOR A TRAIN.

man from the side of the car. It may also be thrown into another position, which allows the dynamo to charge the battery.

The dynamo shaft is connected with the axle of the carriage by means of a friction gear, shown in Fig. 1. Another view is given in Fig. 2; Fig. 3 shows the arrangement fitted with a gear case. By means of a powerful electromagnet, the friction wheels can be put out of gear, and this is done automatically as soon as the voltage at the terminals of the dynamo passes a certain limit. Fig. 4 shows the friction wheels and the magnet *M*, as dismounted.

The winding of the electromagnet is connected across the terminals of the dynamo, and thus the strength of the magnet increases with the speed of the train. When the train reaches the speed for which the magnet armature is adjusted, the latter is attracted against the tension of the spring *S*, thereby lifting the friction wheels. The speed of the dynamo tends to fall off, and the pressure of the spring again comes into play in opposition to the magnet. The position of the armature disc may be easily adjusted for any desired speed by inserting a wrench through the car floor at *P*. With the same wrench the tension of the spring at *T* may also be altered if necessary. No matter how great the velocity of the train may be, the dynamo will never exceed that speed which is necessary to produce the requisite voltage.

The wear upon the friction rollers is quite inappreciable, inasmuch as no slip on the surface of the same takes place; even if sand should get between the wheels, it would not cause any wear. As there is no appreciable loss of energy by friction, the efficiency of the gear is, it is said, consequently very high. It may be said that the electromagnetic device in its action produces a certain dancing of the wheels, causing the power to be transmitted at impulses. The speed of the dynamo, however, remains practically constant, so as not to produce any fluctuation of the light. When the battery is connected in parallel to the dynamo, the light is no steadier than when the dynamo alone is in operation.

Should the speed of the train decrease to such an extent that the dynamo is incapable of producing the requisite voltage, an automatic cut-out with shunt and series winding (Figs. 5 and 6) switches the dynamo off, leaving the battery to supply the current for the lamps. At the same time a resistance, *K*, which was in series with the lamp-circuit as long as the dynamo was charging the battery as well as feeding the lamps, is short-circuited. As soon as the train resumes its speed, the same apparatus switches the dynamo in again. An ingenious contrivance is provided, which changes the leads of the dynamo as soon as the direction of the train reverses. This only comes into action at low speeds of the train; at a high speed, however, it cuts itself out, thus preventing unnecessary wear. The connections for the lighting of a single carriage are shown in Fig. 7, while Fig. 8 shows the connections for a train, one dynamo being used.

Before this system was made public, the inventor, in co-operation with two prominent German companies, made exhaustive experiments in order to arrive at the best construction. The system has been patented in the United States.

German Direct-Current Motors with Adjustable Speed for Driving Paper Machinery.

BY R. GUNDEL.

To drive paper machines with variable speeds, up to the present time steam engines have generally been used, the speed of which is adjustable between somewhat narrow limits. Greater variations of speed have generally been accomplished by some sort of mechanical gearing, but this method is usually very complicated and troublesome. Recently, however, electric driving has come into use. For many machines in paper mills, a rather large variation of speed is necessary, so that the maximum speed required may be six times the minimum speed. The design of electric motors for this purpose is quite difficult, especially if they are not to be too expensive. The conditions are, however, more favorable when two voltages are available with an armature with only one commutator.

The results which have been obtained with two motors of this kind, made by the "Gesellschaft fuer Elektrische Industrie," Karlsruhe, Baden, Germany, are given in the curves of Fig. 1. They show that the efficiency is nearly constant for all speeds, the dimensions of the machines having been determined with this point in view. The regulation of speed is accomplished by variation of the magnetic field flux; at the lower speeds the motor is operated at 110 volts; at higher speeds at 220 volts.

The regulation is by means of the rheostat, shown in Fig. 2. For diminishing the field strength, nine main steps are provided. To vary the field still more in the intervals between these main steps, another regulating rheostat is provided with shorter steps. In this way it is possible to regulate the speed between 125 and 750 revolutions, or between 150 and 900 revolutions, in about 270 steps, each corresponding to a variation of about 2 or 3 revolutions. For every speed and from no load to full load the motors operate without sparking at the brushes, and without any shifting of the brushes.

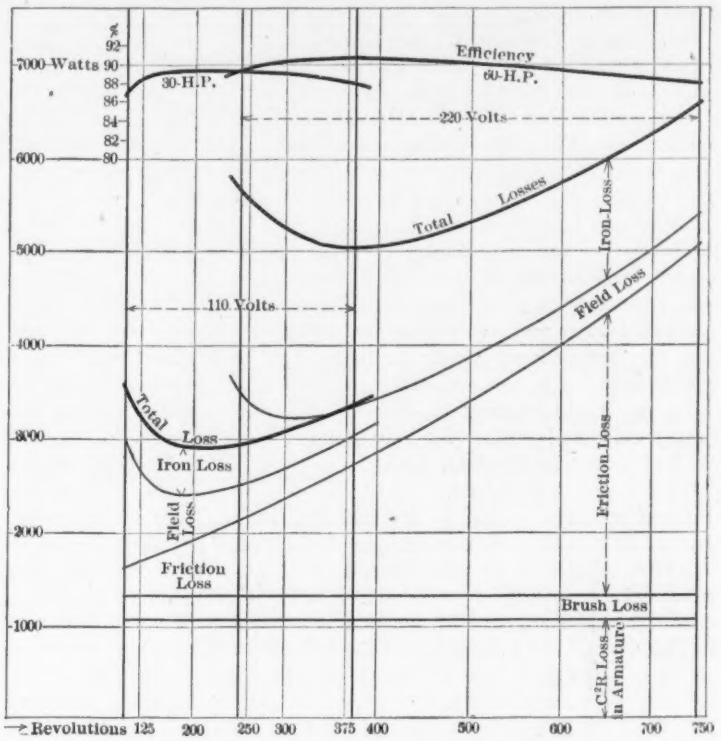


FIG. 1.—30 TO 60-HP MOTOR, 125 TO 750 R. P. M.

Concerning the construction of the motors, it may be briefly said that the magnet frame and the magnet cores are made of cast steel. The pole shoes are laminated, and their geometrical form has been

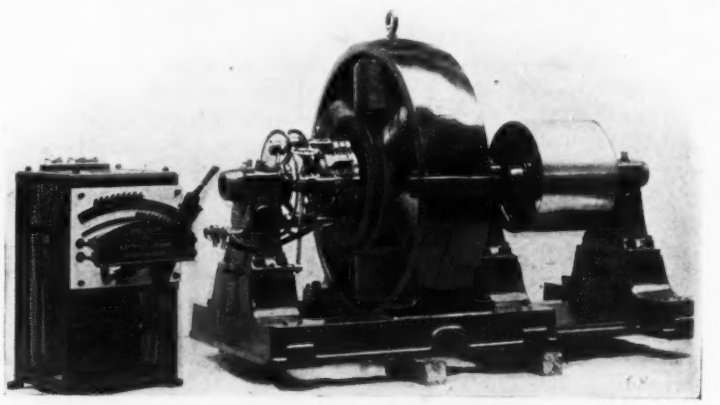


FIG. 2.—REGULATING RHEOSTAT.

chosen with a view of getting a magnetic field favorable to good commutation. The armature has open slots with four bars per slot. The commutator is made of hard-drawn copper, and the brushes are of carbon.

Several motors of this type have been in operation for some time in Germany, and have proved very satisfactory in every respect.

Wireless Telegraphy to Catalina Island.

Catalina Island, California, in the Pacific, has been joined to the mainland by the Pacific wireless telegraph, "a purely American system, now in successful operation," and has exchanged congratulations on the subject with President Roosevelt.

Practical Central Station Information.

One of the queries from the "Question Box" at the Cincinnati Meeting of the National Electric Light Association, was concerning the best voltage of generators for a central station when about one-half the current is for local distribution within a radius of five miles, and the other half to be raised to high voltage for long-distance transmission.

Mr. Dudley Farrand, of the United Electric Company, of New Jersey, expressed the opinion that under the condition named, generators of 2000 to 2400 volts would be suitable. Mr. Henry A. Pierce, of the Pawtucket Electric Company, said that his electrical superintendent considered that the voltage might be 3300. Mr. H. Grissinger, of the Buffalo General Electric Company, was of the opinion that in a large station, the load of which is divided between local service and long-distance transmission, the best practice as to generator voltage is undoubtedly that voltage which is best suited for the local service. For a radius of five miles, if the load is a large one, 4400 volts may be required, while the character of load may be such that 2200 volts would suffice. For the long-distance service step-up transformers would be necessary, and these would cost approximately the same whether the generator voltage were 400 or 4000. It would be poor practice to use one generator voltage for local service and another for long-distance work in order to dispense with step-up transformers, for the reason that the flexibility of the station would be impaired.

Another query related to the best practice with regard to underground distribution and connections to consumers' premises, for a system embracing both 500-volt direct current, 1000-volt alternating current, and direct current series arc. Mr. E. W. Rollins, of Hartford, Conn., in reply said that the question as stated is rather a difficult one to answer, lacking knowledge of the volume of the business, the territory covered and other necessary information upon which to base an intelligent answer. First of all, he thought the system should be simplified so as to supply the outskirts of the city with alternating current of such a character as to meet the requirements for light, power, etc. In the center of this lighting district, it might be advisable to install a three-wire direct-current system, 110-220 volts, for light, power and general uses. The best plan of distribution for direct-current systems would be to run three mains consisting of 3 cables on each side of the street, as close to the curb as convenient, making lateral connections to each building; in some cases one lateral may answer for two or more buildings. The connections can be made up in small hand holes in the street. The lateral ends, or service, should be made up to a water-proof cartridge-fused switch. The ordinary slate or marble-based switch is liable to corrode and cause trouble owing to the dampness to which they are exposed. The mains referred to should receive the supply of current from junction boxes placed in sewered manholes, at points to give a uniform pressure and even distribution of load on the various feeders supplying current to the system. This same system can be employed for alternating current distribution, placing subway transformers in manholes for the supply of current. At Hartford the enclosed primary fuses are placed on a pole, adjacent to the manhole containing the transformer.

In response to a query as to the relative cost of trimming and maintaining inclosed arc lamps as compared with furnishing free renewals of glow lamps, Prof. L. B. Marks said that it costs about four or five times as much to trim and maintain inclosed-arc lamps as it does to furnish free renewals of glow lamps. One trimmer can conveniently take care of approximately 300 commercial arc lamps. He can, of course, trim a great many more, but will be compelled to neglect a great many lamps that need attention.

Assuming an average burning of three hours per day or approximately 45 kw-hours per month for each lamp, the life of one trim being 100 hours and the life of the inner globe 600 hours, the 300 lamps would consume approximately 13,500 kw-hours, 270 carbons and 45 inner globes per month. The expense, not including repairs therefore, would be as follows: One trimmer, $55; 270 carbons at 3 cents each, $8.10; 45 globes at 10 cents each, $4.50; or a total cost of $67.60, thus making the cost approximately five mills per kw-hour.

Assuming the life of an incandescent lamp to be 600 hours, consuming 50 watts or thirty kw-hours during its useful life, and the lamp costing 15 cents in the store house, the total cost is five mills per kw-hour. This cost does not include the delivery of lamp renewals to customers, which is generally customary; but figuring on a storehouse basis for incandescent lamps and trimming arc lamps, there is thus very little difference in the cost. It is assumed that the customer owns the arc lamps.

A query which, judging from the number of responses, elicited much interest, was one asking which is preferred on alternating-current systems to indicate regulation: A system of pressure wires or a compensating voltmeter. Mr. W. T. Oviatt, of the Connecticut Railway & Lighting Company, pronounced in favor of a compensating voltmeter for long distance, and pressure wires for short distance. Mr. H. T. Hartman, of the Electric Company of America (Philadelphia), said that in its Edison three-wire plants his company has had excellent results from the use of pressure wires, which are run to the office of the company situated practically at the center of distribution and there connected at will by means of a voltmeter switch to any one of the various ends. As it is customary to regulate the central-station voltage according to some standard feeder, only one main set of pressure wires is really required, and the plan above outlined enables one to test the voltage at feeder ends when required for comparison. It also avoids the necessity for occupying valuable space on the main pole lines by a multitude of small pressure wires. At the central office there is a pair of Bristol recording voltmeters connected to any desired set of pressure wires. The manager examines the charts every morning and sends them to the chief engineer or station superintendent, who makes such notes as he may require for the guidance of the switchboard attendants. This plan works admirably in practice, the regulation being good and lamp breakage low in proportion to the number of lamps connected.

Mr. E. J. Bechtel, of Toledo, Ohio, expressed the opinion that in alternating current distribution compensating voltmeters have an advantage over pressure wires returning from long distances, in that they are simpler, not apt to be out of order when wanted, less maintenance and just as reliable when adjusted and used in connection with systematic tests and inspections at the consumer's connection. This inspection is advisable under any system.

Mr. F. L. Sargent, of Malden, Mass., preferred compensating voltmeters over pressure wires on the system of his company, as this system is entirely overhead, and using pressure wires necessarily makes so much more overhead construction to maintain and causes trouble during storms. There is very good regulation, using practically the same method as compensating voltmeters. Mr. F. Ellwood North, of Somerville, Mass., said his company used to have pressure wires on every feeder. Last fall it installed compensating voltmeters, doing away with pressure wires, and they answer every purpose. He much preferred compensating voltmeters. Mr. Chas. H. Peters, of Denver, Colo., unhesitatingly favored pressure wires in place of compensating voltmeters, although aware that the makers claim they will compensate for any ordinary drop on lines. These are in use upon four of his company's circuits, but are anything but satisfactory; in fact, a man by means of hand regulation can come nearer making up for line drop by guessing than he can by keeping a voltmeter on the dot and relying upon the action of the compensator.

Mr. Jas. E. Pyle, of West Chester, Pa., considered that it would depend upon local conditions. If three-wire secondaries are used, the three pressure wires would surely gives satisfactory results, providing it did not cost too much to erect and maintain the pressure wires. If the pressure wires were tied into the secondaries some distance from the transformer, they would indicate the load balance on the secondary of the transformer in many cases. Compensating voltmeters with due care in balancing the load on three-wire secondaries, in case three-wire secondaries are used, should be much less cumbersome and in most cases preferable.

Mr. P. Junkerfeld, of the Chicago Edison Company, was of the opinion that in an alternating current distribution system compensating voltmeters arranged for inductive and non-inductive drop are preferable to a system of pressure wires. The first cost, as well as maintenance, will be less, and if compensating voltmeters are properly adjusted, better results will be obtained.

In reply to a query as to the practicability of using three pressure wires on a three-wire secondary system, Mr. Pyle said that a system of pressure wires having a common neutral would not indicate the pressure at the different parts of the system as well as separate neutrals would. In case of a bad balance on any part of the lighting system, the difference of potential between the two outside wires could remain standard, while the heavily loaded side would be low, and the lightly loaded side would be too high. Mr. Chas. H. Peters, of Durango, Colo., said that so far as he could see, there would be no objection to using three pressure wires upon a three-wire system, although the neutral pressure wires would be expensive. Mr. Pyle concurred, if the primary feeders are short; if the primary feeders are very long the maintenance of the pressure wires would be expensive.

Recent Electrochemical Developments.

CLINTON PAUL TOWNSEND.

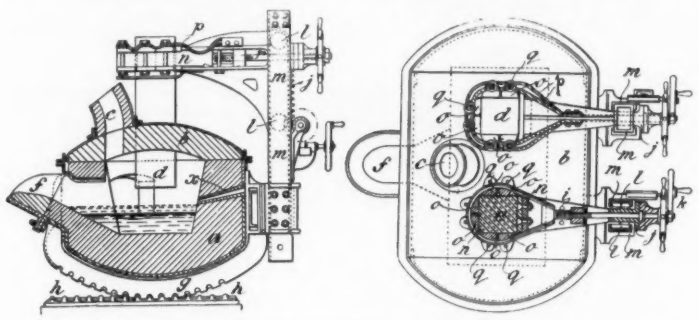
THE PRODUCTION OF OZONE.

It has long been known that the form assumed by the electric discharge through air determines the character of its chemical effect. For the production of the allotropic form of oxygen, known as ozone, the diffused discharge is best suited, whereas it is now shown by the work of Bradley and Lovejoy that the oxidation of nitrogen proceeds best in or around the high-voltage, direct-current arc. The spark occupies a middle ground in respect to both reactions, having as regards the oxidation of nitrogen about one-eighth of the efficiency of the arc, and exhibiting a somewhat larger fraction of the ozonizing power of the diffused discharge. It is, therefore, merely a coincidence that the nitrifying device and the ozonizer should, in their latest development, so closely approach each other that the distinctive feature of each is the passage of the discharge between relatively moving terminals.

In the nitrifying device the purpose is to strike, elongate and extinguish a number of arcs in rapid succession; in the ozonizer it is to quickly extinguish any arcs which may form, such arcs bearing the relation to the diffused discharge of a short-circuit. In the ozonizer the result may be accomplished by the rotation of one or both electrodes, or by the movement relatively to either of a dielectric skeleton frame. Each of these forms has been described by M. Marius Oto, of Neuilly, France. In the several forms heretofore described, the diffused discharge passes between a series of points carried by the respective terminals; in the latest type of apparatus, however, plane discs are used, the two outer ones being stationary, water-cooled, and of the same polarity, while the central revoluble disc forms the opposite terminal. Provision is made for interrupting such arcs as may form by facing the inner side of each stationary plate with a thin dielectric film, and by inserting into the revolving plate a series of radial strips of ebonite. The usual provision is made for distributing the current of air over the opposing surfaces of the plates.

ELECTRIC FURNACE.

An electric furnace for the direct production of steel is the invention of M. Paul Louis Toussaint Héroult, of La Praz, France. The dominant idea of a Bessemer converter, swung upon trunnions and fitted with tuyeres, but provided also with electrodes as an auxiliary means for furnishing the heat necessary for maintaining the metal in fusion, appeared early in the history of the art, and reappears in



HEROULT ELECTRIC FURNACE.

the present device. In the usual converter the heat is derived from the oxidation of silicon, phosphorus, and other metalloids present as impurities, and the addition thereto of means for maintaining the heat in the absence of such impurities considerably extends the field of converter operations. The furnace itself is simply constructed, as shown herewith; it is of the usual converter form, provided with a lining, *a*, *b*, pouring lip, *f*, chimney, *c*, and is mounted for oscillation upon combined cog and guide-rails, *g*, *h*.

The electrodes, *d*, are two in number, and the arcs are struck in series, thereby avoiding the necessity for an electrical connection to the metal. These electrodes are carried by standards, *m*, rigidly attached to the converter, whose movement they therefore share. The terminal connections, *p*, *q*, to the carbons, *d*, are through a series of copper wedges, *o*, forced between the carbon and a surrounding metal collar, *n*. The tuyeres, *x*, lead from a wind-chest carried between the base of the converter and the standards, *m*. For the rack and pinion, *h*, *l*, *j*, shown as serving for adjusting the carbons, the inventor suggests and claims the substitution of hydraulic cylinders; the same devices may also be employed for oscillating the furnace Instead of the lip *f*, the mouth of the converter may be prolonged into a ladle, from which the metal may be cast direct.

SOLUTION OF MINERAL PHOSPHATES.

Messrs. Wiborgh and Palmaer, of Stockholm, Sweden, patent a process for converting the insoluble or mineral phosphates into the so-called reverted salts—a process so rational and withal so simple that it is somewhat remarkable that it has not been before suggested. There are three distinct phosphates of calcium, the mono-, di- and tri-basic salts, the first being soluble in water, the second in certain neutral salt solutions, and the third in acids. Agricultural value decreases in the order named. The present process contemplates the conversion of the tri-basic or insoluble phosphate into the di-basic salt, and consists merely in placing the ground rock in the anode compartment of a diaphragmed cell, containing as an electrolyte a solution of any salt, as the nitrate of an alkali metal, whose acid radical forms a soluble combination with calcium. The phosphate dissolves in the acid liberated at the anode, to be reprecipitated in the di-basic form by the base which is simultaneously formed at the cathode; the reactions involve the regeneration of the electrolyte. In commenting a few months ago upon the Cheeseman process for the solution of natural phosphates, it was remarked that the efficiency of the method would be increased if the solvent effect were limited to the immediate region of the anode; this is, in fact, the principle of the present method.

President Roosevelt in a Trolley Accident.

On Wednesday of this week, President Roosevelt had a narrow escape from death while on his way in a carriage from Pittsfield to Lenox, Mass. The carriage was run down and wrecked by a trolley car, William Craig, a secret service agent, who was acting as a body-guard to the President, being instantly killed. The President received a blow on the right side of the face, which caused the swelling of the right cheek and the blackening of his right eye. Blood was drawn from a scratch on the cheek. With the President in the carriage were Governor Crane, of Massachusetts, and the President's secretary, Mr. G. B. Cortelyou, both of whom were bruised and cut.

The evidence that has been gathered so far points to the conclusion that the accident which brought about these casualties was due to the desire of a Pittsfield electric railway motorman to get his passengers to the Country Club before the President's cavalcade should pass the house. The motorman, Luke Madden, a new man at his employment, was arrested, as was the conductor, James Kelly.

The accident occurred about 3½ miles out of Pittsfield, about 200 yards from the Country Club, toward which the President and some of his party were being taken.

The President, after assuring the members of his party that he was not seriously hurt, approached the motorman, and, shaking his fist under the latter's nose, said "If your car got out of control, if it got away from you, why, then, that is one thing. But if it is anything else, this is a damnable outrage!"

"You don't suppose I tried to do it, do you?" growled the motorman, who instinctively recognized Theodore Roosevelt. As the President turned away, the motorman shouted back to him, "Well, I had the right of way, anyway. You had a right to look out for yourselves."

After the wreck was cleared away and the injured were properly cared for, the presidential trip was resumed, but the sad event marred the pleasure of the remainder of the day.

Recovering Swallowed Gems.

A recent telegram to a daily paper from Greenwich, Conn., says: Mrs. W. McMaster Mill's diamonds, which her pet bulldog, Sport, swallowed on Tuesday afternoon while playing on the bed in the room where the jewels lay, were recovered to-day, and the animal has since been allowed his freedom. Mrs. Mills told her fellow-boarders at the Silleck House this morning that she had the three rings again, and that the dog had truly swallowed them, as she suspected. They were uninjured, Sport having taken them like pills. The dog had been under a veterinary's care, and last night X-ray were used on him, and the location of the jewels was discovered.

New Telephone Patents.

Patents on telephone receivers have been happily rather scarce of late, and it is the irony of fate that the single telephone patent of the issue of August 19th should relate to the freakiest kind of a freak receiver. Mr. Lemuel Mellett, of Somerville, Mass., who is responsible for this addition to the innumerable family of telephone receivers, with the aim to make a receiver more sensitive and loud-speaking, not only suspends the diaphragm between two springs but mounts in the case a number of "harmonic vibrators," adapted to vibrate in sympathy with the diaphragm and so to reinforce its vibrations.

Referring to the drawings, 1 is a cup-shaped steel casing in which is mounted magnet-core, 2, carrying coil, 3. The core, 2, forms one pole of the magnet, and the periphery of case, 1, the other. The diaphragm is simply held in place by cover or ear-piece, 7, and not clamped down tightly on 1 by it. The center of the diaphragm is supported between two conical-coiled springs, 9, 10, one of which rests against the lower side of the cover 7, and the other on the top of the coil 3. This method of suspending the diaphragm allows of the use of a thinner diaphragm than is ordinarily employed, which "will vibrate more freely in all portions, and thus give better acoustic effects." The function of the "harmonic vibrators" had best be described in the inventor's own words: "In the space behind the diaphragm, 6, I locate a series of harmonic vibrators, 11, 12, having their outer ends secured to the side wall of the casing, 1, and their inner ends left free to vibrate, and directed radially inward toward the center of the casing. These vibrators, which are shown both in the form of reeds and of small helical springs, are of different lengths, so as to emit different fundamental tones when vibrated,

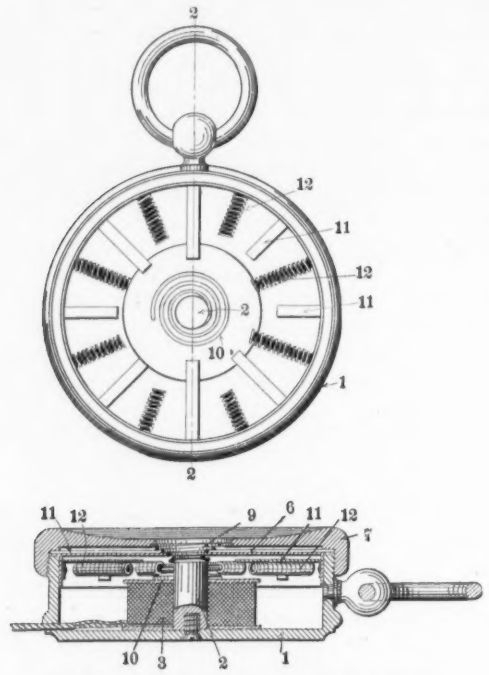


FIG. 1.—MELLETT TELEPHONE RECEIVER.

and are shown as 16 in number, corresponding to two octaves. A greater or less number of vibrators may be provided, or vibrators of a different character. When the diaphragm, 6, is set in vibration by a magnetic impulse, received in the electromagnet, emitting a given tone or tones, one or more of the vibrators, 11, 12, will be sympathetically or consonantly vibrated and will have the effect of reinforcing and perpetuating the vibration of the diaphragm, and thus increasing the loudness of the tone emitted thereby." It seems that Mr. Mellett has invented a transmitter which is also garnished with "harmonic vibrators," for he says that "in connection with a receiver of this character the best results are obtained by employing a transmitter constructed as described in a patent, No. 667,546, granted to me February 5, 1901, and tuning the vibrators in each instrument alike."

The issue of August 26 contributes but one patent to telephony, covering a circuit-closing device, the invention of Mr. A. B. Chance, of Centralia, Mo. The object of the invention is to dispense with the use of a generator at the subscriber's station and to provide means actuated by the receiver hook for calling central and for automatically throwing the drop or annunciator at the central office to secure a positive "ring-off."

Referring to the drawings, that to the left shows a diagram of connections, and the others details of the improved switch-hook. The usual contacts for cutting off the bell circuit and throwing on the talking circuit are made by the rear extension of the hook by means of the bridge piece 9, which makes contact with the upper spring 10 when the hook is down, and with

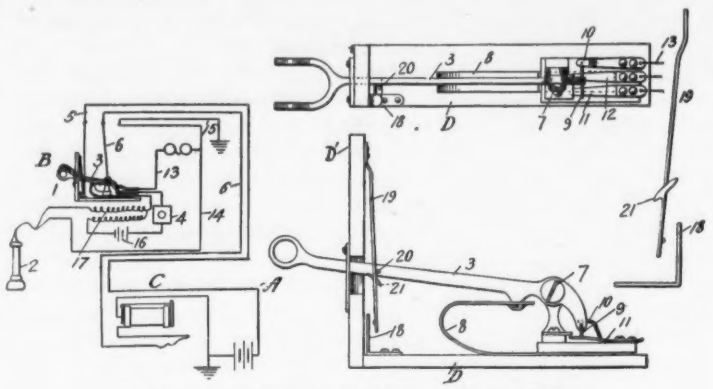


FIG. 2.—CHANCE AUTOMATIC CIRCUIT CLOSER.

the two lower springs 11 and 12 when the hook is up. The circuit-closing device consists of the contact plate 18, to which line wire 5 is connected, and the spring 19 having on one side an inclined contact-piece 21. The pin 20 on the hook rides on the under cam surface of 21 when the hook is raised, pressing spring 19 outward, and on the upper surface when the hook is depressed, then forcing 19 into contact with 18 and so completing the circuit between the two line wires, by 6, hook 3, pin 20, plate 21 and spring 19, causing the battery to throw drop *C*.

To call, the subscriber after removing the receiver presses the hook down, thus closing 19 on 18 and throwing the drop; he then releases the hook and in returing pin 20 rides underneath 21 and clears it. When the receiver is replaced, 19 is again closed on 18 giving a "ring-off" signal. Mr. Chance's little device is ingenious, but the modern common battery system is even a little more automatic.

A patent not previously noticed, which was granted July 22 to Arthur T. M. Thomson, of East Dulwich, England, covers an idea in the location of supervisory signal lamps which is not likely to be of much practical value. Mr. Thom-

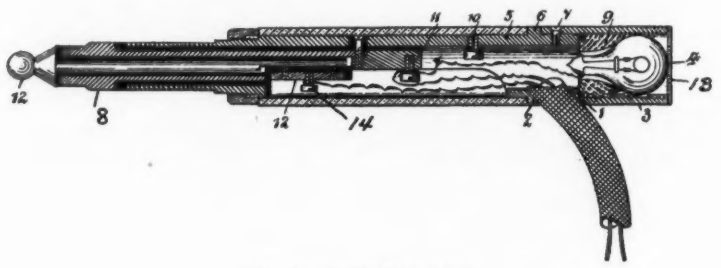


FIG. 3.—THOMSON PLUG.

son's improvement consists in setting the lamp in the base of the plug. The drawing shows the suggestion sufficiently not to need any description. We say "suggestion" because such a plug would be so unhandy and so difficult to dispose of in a telephone switchboard that no sane telephone engineer would dream of putting it there. Plugs and cords give quite enough trouble at present, and a miniature incandescent lamp is much better off in a stationary socket.

The Alaska Cable.

News has been received at San Francisco, via the steamer "Cottage City" that the cable between Skagway and Juneau is again in working order. Sergt. Bruck opened it for commercial dispatches August 25. The cable has given a great deal of trouble, but it is said to be giving good service now, and little further trouble is anticipated.

CURRENT NEWS AND NOTES.

BERLIN'S LAST HORSE-CAR.—A cable dispatch from Berlin says: "The last horse-car has disappeared from Berlin's streets, owing to the abolition of that means of transportation in favor of more modern conveyances." In this dispatch "more modern conveyances" means the plain old-fashioned trolley, among other things.

THE HIGHEST LIGHTING PLANT was recently illustrated and described by *Harper's Weekly* as being in Bogota, South America, at an elevation of 8,300 feet above sea level. Mr. W. R. Swank, of Stratton's Independence gold mine, in the Cripple Creek district, Colorado, now claims the "highest" for that mine, the elevation being 10,000 feet. Perhaps even this is not the highest in the world.

MARCONI AT WORK.—A cable dispatch from Ferrol, Spain, of August 30, says: "Signor Marconi, aboard the Italian cruiser "Carlo Alberto," says he is in constant communication with Berlin, as well as with British warships, from this station and from Cornwall. Signor Marconi declares that he has solved the problem of maintaining the integrity of individual simultaneous messages." Mr. Marconi was received recently by the Czar, and treated by him with great honor.

LIGHTING SQUABBLE AT HAVANA.—A cable dispatch from Havana, of August 30, says: The Municipal Council of Havana to-day passed, almost unanimously, a resolution asking the House of Representatives to impeach the Secretary of Public Works, Manuel Luciano Diaz, for granting a concession for the electric lighting of Havana, on the ground that the act of the secretary was unconstitutional, as the granting of municipal concessions is within the province of the Municipal Council only. It is thought that the House of Representatives, backed by the influence of the Municipal Council, may take some radical action in the matter.

NEWS FROM PARIS.—Max O'Rell, the well-known literatteur, is evidently a little off in his knowledge of electricity, as witness the following news furnished by him from Paris: "It is not sufficient for the Parisians to have to avoid their cabs which aim at them, or to do their best to get out of the way of the automobiles, which are allowed to go at the rate of 30 miles an hour in the main thoroughfares of Paris, but they will have to be careful to escape electrocution on the very wood pavements. In many parts of the French capital the street-car rails press so much on the wood pavement that the cables, which supply electricity, transform the surface into an electric battery. The other day, on the Avenue de la Republique, it was amusing to witness horses and foot passengers executing wild dances over which they had no control."

MISSISSIPPI POWER.—At the coming meeting of the Trans-Mississippi Commercial Congress, at St. Paul, a proposition will be submitted for damming the river at Keokuk, the foot of the Des Moines Rapids. If Congress will permit the obstruction, the fall will afford 60,000 electrical horse-power for commercial use. Between Leclaire and the cities of Rock Island and Davenport, the river falls 24 feet in 14 miles. Below this fall is another, between Montrose and Keokuk, where the river falls 23 feet in 12 miles. In addition to the normal fall there is another source of power in the flood water. The river fluctuates in level to the extent of 51 feet at Cairo, and the variation is about 15 feet as far down as New Orleans. All along this course there are valleys in which private enterprise might impound flood water, to be used for power after the main stream had fallen to its normal level.

N. E. L. A.—The National Electric Light Association reports the following new members: Akron, Ohio—The Northern Ohio Traction Company; Bellevue, Pa.—Ohio Valley Electric Company; Canon City, Colo.—The Colorado Electric Power Company; Danville, Pa.—Standard Electric Light Company; Dixon, Ill.—Dixon Power and Lighting Company; Ionia, Mich.—Ionia Electric Company; Kenosha, Wis.—Kenosha Gas and Electric Company; Leipsic, Ohio—Leipsic Electric Light, Heat and Power Plant; Lyons, N. Y.—Wayne Country Electric Company; Lynchburg, Pa.—Lynchburg Traction and Light Company; Niagara Falls, N. Y.—Buffalo and Niagara Falls Electric Light and Power Company; Pottsdam, N. Y.—The Pottsdam Electric Light and Power Company; Pocatello, Idaho—The American Falls Power, Light and Water Company; Richfield Springs, N. Y.—Richfield Springs Electric Light and Power Company; Rhinelander, Wis.—Rhinelander Lighting Company; Stockton, Calif.—Stockton Gas and Electric Company; Waynesboro, Pa.—Waynesboro Electric Light and Power Company. The Association has just issued a printed list of membership up to August 1.

AMERICAN ELECTRIC AND AUTOMOBILE PATENTS MONTHLY.—The third issue of this important patent publication covers the month of March. Every patent issued during that month relating to electricity and automobiles is represented by all of the drawings, a brief of the specifications and all of the claims. A feature of particular value is an appendix, giving the number, name and date of references cited in examination of applications. As an example, we quote the following references to the transformer patent, granted March 18 to Thomson and Houston on an application filed Feb. 19, 1887. The numbers refer to patents cited: Zipernowski et al., 352,105, Nov. 2, 1888, and March 3, 1885, Austria; Gaulard & Gibbs, 351,589, Oct. 28, 1886; see article in *Engineering*, March 3, 1888, p. 205; Ripley, 347,642, August 17, 1886; 14,190, 1852, England. Interference with application of W. K. Freeman, Astoria, N. Y.; A. Bernstein, Boston, Mass.; R. M. Hunter, Philadelphia, Pa.; patent to Gaulard & Gibbs, Oct. 28, 1886, 351,589; E. Thomson, Lynn, Mass., and E. Thomson, Lynn, Mass.; decision unfavorable. Interference with application of W. K. Freeman, Brooklyn, N. Y.; Westinghouse Electric Company, Pittsburg, Pa., and J. D. Gibbs, Middlesex County, England; decision favorable to Freeman. Another patent granted to Alfred C. Gilmore on an automatic telegraph was the subject of 24 citations of patents, dating from 1868 to 1901.

MERCURY VAPOR LAMP.—In his experiments with mercury vapor lamps, Mr. Cooper-Hewitt established that a fixed relation should exist between the cross-sectional area of a tube and its surface. It has also been found that the highest efficiency is obtained with a small area of cross-section and a large section of surface. In a patent, issued August 26, to Henry Noel Potter, it is also stated to be advantageous to increase the radiating surface and decrease the cross-section of the luminous stream, for the specific reasons that the portions of gas or vapor lying near the surface of the luminous stream are somewhat opaque to the light rays given off by the more central portions of the gas, and that the vapor mercury has a temperature of maximum efficiency beyond which it is easily possible to heat it. To meet these several conditions a tube is described, the central portion of which is occupied by a glass rod or tube, thereby confining the vapor stream to a contracted annular passage; and to counteract the tendency of the mercury vapor to become heated to a temperature above that of maximum efficiency, the vapor tube is surrounded by a vacuum jacket of glass. Another detail consists in the use of a heating wire coiled about the vapor tube. The arrangement of circuits is such that in starting up, a current is passed about this heating coil in order to warm up the vapor of the lamp, and as soon as sufficient conductance has been thus obtained, the heating circuit is automatically interrupted and the tube operates normally.

LETTERS TO THE EDITORS.

Graphical Calculation of Synchronous Motors.

To the Editors of Electrical World and Engineer:

Sirs.—From Prof. Blondel's letter in your issue of August 16, it would appear that he considers that I made use without due credit of material published by him. In this connection I wish to say that I never read any of the articles to which Prof. Blondel refers, and that the method which I published in your columns of May 17, 1902, is an application of a general method of making alternating current calculations developed and published by me under the title of "An Alternating Current Calculating Device."

STANFORD UNIVERSITY, CAL. F. G. BAUM.

Humming of Telephone Wires.

To the Editors of Electrical World and Engineer:

Sirs.—On page 175 of your journal of August 2, 1902, it is stated that Mason Grover, of Bidwell, Ohio, has obtained a patent, dated

July 22, for a damper designed to prevent the humming of telephone wires. I take the liberty of observing that this is a very old device. The German Reichs-Post has been using these rubber dampers for the past fifteen years. It is a well-known fact that in Germany all telephone wires are aerial and carried over the house-tops on iron poles fastened to the roofs and spaced about 150 feet apart. These iron poles are provided with iron cross arms, which are the points of attachment and support for the wires. In order to prevent the noise in the wires produced by vibrations of the air and which noise is transmitted through the entire house or houses used as a support for such wires, especially for the winter months, the German Reichs-Post uses these rubber dampers and by them deadens the singing of the wires. The rubber cylinder is about four inches long and one-half inch in diameter, and is split lengthwise. After the rubber cylinder is in place on the conductor it is bound spirally with very fine wire to keep it in place. Thus you see this so-called invention is as old as Methusalem.

NEW YORK CITY. GEO. D. ROEDELSPERGER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Rating of Motors and Generators.—RASCH.—His recent Internat. Tramway Union paper in full. It is a report on the question what basis should one adopt in estimating the power of motors and generators, taking into account the different elements which may enter into this calculation, such as output, speed, torque, heating, etc. In rating the power of a motor, a distinction should be made between the power received by the motor and that given out by it. He, therefore, recommends the German terminology, according to which mechanical power should always be given in horse-power, and electric power in watts. It follows that a motor of 25-hp is always a motor which gives out, and not one that receives, 25-hp. In giving the power of a motor there should always be added to it an indication of the kind of service—whether intermittent service or momentary service or continuous service and when dealing with a momentary or intermittent service there should also be given the number of hours corresponding to the length of the service. It is, in fact, evident that the same machine may for each of the three categories of service yield quite different powers. The German regulations determine as the normal power of a traction motor that which in the test room can be yielded during one hour without causing the temperature to rise above the admissible limits. The author thinks that the trial of one hour is insufficient. He gives a formula for determining the duration of the test, according to the conditions of the service. The number of hours during which the motor should be tested under full load is the excess of the temperature over that of the atmosphere, multiplied by the number of hours during which the motor is working in service, divided by the sum of the temperature excess and 28 times the number of hours during which the motor is not subjected to the electric current. Concerning overload, tramway engineers are, in general, of the opinion that an overload of 40 per cent. during three minutes should be regarded as insufficient. One company suggests an overload of 100 per cent. during some seconds, another one goes as far as even to require this overload for a period of five minutes, and requires at the same time that the limit of admissible heating shall be diminished by 20° C.; the author does not believe that this diminution is justified. Concerning the limit of temperature, he quotes the results obtained by Dettmar: a temperature of 95° C. may be considered as perfectly admissible for stationary windings; on the contrary, for the rotating coils this temperature of 95° C. should be regarded as an extreme one, and is not to be allowed in a well-adjusted machine. Besides, as an atmospheric temperature of 35° C. is in no way extraordinary, it results in the case of a cotton insulation that a limit of 60° C. overheating is permissible. The author suggests that a manufacturer should give for half-load, normal load, and 50 per cent. overload, the following: the current in amperes, the torque in kilogram meters, the number of revolutions per minute, and the efficiency. Concerning efficiency, it will be necessary to specify in every case if the efficiency of the motor alone is required or that of the whole car. This latter information will naturally be asked for, when the motors and car trucks are ordered from the same factory.—Lond. *Elec.*, August 8.

Definition of Armature.—SINGER.—A communication in which he recommends defining the armature (anker) of an electric machine as "that part in which the lines of magnetic flux, produced by the primary excitation, are to be closed."—*Elek. Zeit.*, July 24.

DETTMAR.—A communication in which he criticizes the recent suggestion of Ziegenberg (duly noticed in the Digest), and defends the definition of the committee of standardization of the Association of German Electrical Engineers. In an induction motor, both stator and rotor are armatures; the one is the primary armature, the other the secondary armature.—*Elek. Zeit.*, July 24.

REFERENCE.

Frame for Alternators.—BOEHMLAENDER.—A brief paper, read before the Berlin Electrical Society, on a new frame construction for alternating-current machines, used by Siemens & Halske. The construction is well shown in several illustrations.—*Elek. Zeit.*, July 24.

POWER.

Electric Hoisting Machines in Mines.—A profusely illustrated article on electrically-driven hoisting machines. The first machines described are installed at a mine in Dortmund for hauling from a depth of 2,296 feet, 100 tons of coal per hour. The machine is worked by a 2,000-volt, three-phase induction motor, the armature of which is keyed directly on the pulley shaft. The starting and speed regulation of the motor are effected by a liquid resistance in the rotor circuit. Each of the three phases of the rotor circuit is led to electrode plates; these are insulated and suspended in a tank, in which circulates a solution of soda. As usual, the resistance in the circuit decreases in proportion as the solution is made to rise in the tank, causing the motor to run at a higher speed; full speed is reached when the solution is at its highest level in the tank. The power-house contains three 550-kw, three-phase alternators, the frequency being 50; they supply, besides the hoisting machine, an electric mining pump and apparatus, both in the mine and at the surface. Another installation in a mine in Saxony is also described. Direct-current motors are used here. The starting of the motors and the speed regulations are carried out without the aid of resistance in the main line, and, therefore, without energy losses. Each motor is always supplied by the corresponding dynamo with the necessary current at the required pressure. The dynamo is separately excited by a small exciting dynamo, worked by belting from the steam engine shaft. The controller of the hoisting machine is inserted in the exciting dynamo circuit.—Lond. *Eng'ing*, August 1.

REFERENCES.

Steam Turbines and Engines for Large Generating Stations.—A detailed account of the discussion which followed Fedden and Day's Mun. Elec. Ass'n. papers, recently noticed in the Digest.—Lond. *Elec.*, August 1.

Swiss Power Station.—PERKINS.—An illustrated description of the central station of Romanshorn, Switzerland. The 2,250-volt, three-phase generators are driven by gas engines, their total capacity being 250-hp.—*Elec. Rev.*, August 9.

TRACTION.

Polyphase Traction.—ZIEHL.—A communication in which he criticizes a statement in a recent paper of Niethammer, that "under otherwise equal conditions" a three-phase induction motor absorbs considerably more power and heats up more than a direct-current series motor. The advantage of the latter is that at starting, when the current increases, the magnetic flux also increases; as the torque is proportional to the product of magnetic flux and current, if the torque is increased, the maximum current is not increased to the same degree, nor the heat loss which is proportional to the square of the current. In three-phase induction motors, on the other hand, the field decreases during starting, and this is a disadvantage. But

this disadvantage can be avoided, if the motor is excited by the three phases with 1.73 times the voltage, *i. e.*, the motor is changed from star connection to delta connection, or what is the same, the phases of the transformer supplying the motor are changed in reversed direction. The latter arrangement is used by Siemens & Halske on their experimental high-speed motor-car. He shows that with this arrangement the three-phase induction motor is superior to the direct-current motor during starting in regard to heating. He claims that the three-phase motor is most suitable for fulfilling the problem to get the maximum power from the smallest space, and the highest efficiency with the best conditions of cooling. At the conclusion of his communication, he suggests the following, "mechanical connection in cascade" of one or two motors. Both case and armature revolve around the axle of the motor-car, for instance the armature with the axle rotates in one direction, while the case rotates in the opposite direction; the latter acts on a second axle through a gearing, or it may be connected mechanically to one part of another motor. Both motors mounted on one axle, are suitably so coupled that the armature of each motor is rigidly mechanically connected with the case of the other motor. When rotor and stator revolve with equal speed, a 200-hp, 50-periods, 4-pole motor, directly mounted on the axle, would give about 750 revolutions. Both armature and case transmit each 100 hp, *i. e.*, together 200 hp.—*Elek. Zeit.*, July 17.

Youngstown and Sharon Railway and Light Company.—An illustrated description of this recently completed system. The company owns a large number of electric light companies, street railway companies, gas companies, etc., which were operated independently in the district, and has consolidated these various properties into a unified whole. The various electric power stations of the companies entering into the combination have been discarded, and one central power station has been built for the operation of the entire system. The new central station has a capacity of over 2,000 kw, generating two-phase current at 2,250 volts and 60 cycles. This is stepped-up to 10,000 volts, three-phase, and transmitted to three substations on the different divisions. Lighting circuits are supplied from the same station. The business of the company has so far exceeded the original estimates, that a 1,000-kw generating unit is in contemplation. There are two transmission circuits, so arranged that they may be operated independently or in parallel, as the conditions demand. At times of heavy load the railway, lighting and power business is operated in parallel; but at times, when the load is comparatively light, better results are obtained by operating the light separately from the railway and power circuits, and this method has been adopted. The substations contain 200-kw rotary converters, each station having two machines. Two of the substations contain storage batteries, one of 160 amp.-hours, and the other of 240 amp.-hours. The rail in the streets of the towns is of girder section, but where the track runs on the company's own right of way, T-rail is used. Copper bonds are placed under the plates of the rail joints, and cross-bonds are used every 500 feet. Double trolley wire is used throughout. It also has an electric locomotive equipped with air-brake apparatus and hose couplings, and can be attached to a number of standard steam railroad freight cars if desired. This locomotive has detachable noses, so that it can be used as a snow plow if desired.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Municipal Ownership in England.—PORTER.—A brief history of the present movement, in England, in opposition to municipal ownership, and a summary of the effects which have been produced by the various municipal undertakings now in existence. The backward condition of electrical industries in England is in a very large measure due to the operation of the tramway act of 1870, which enables municipalities to come in at the end of 21 years of operation by private enterprise and practically confiscate the property and goodwill. With the expection of two or three exceptionally well-managed companies' plants, British municipal plants are never so well nor so economically operated as the private plants, nor do they serve the public so advantageously. Electric lighting is found to be in a similar condition. Public ownership of telegraph and telephone franchises has created a great stagnation, and the government lines have complete monopoly, which militates strongly against efficient service.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Electrolysis in Water Pipes.—HUMPHREYS.—A paper read before the British Association of Waterworks Engineers. He gives a general review of the subject, but does not seem to give anything new. There is an appendix, containing the report of a special committee on this subject. In this report it is said that there is no known practical method by which owners of underground pipes can protect themselves against electrolytic injury from single trolley currents, but that there are two methods of operating electric railways by which the return currents are kept out of the ground; the conduit system and the double-trolley system. The conduit system is peculiarly adapted to the larger cities; the double-trolley system, it is claimed, "is entirely practical, possesses many advantages over the single trolley, is more economical in operation and maintenance, and completely stops the injury to the pipes." No connections should be made between pipes and rails or other return conductors.—Lond. *Elec. Eng.*, August 8.

REFERENCE.

Current Distribution on Railroad Networks.—PFORR.—An article in which he describes a graphical method for determining the current distribution in electric railroad lines. He first considers the case of several power houses situated along a single line, at a greater or smaller distance from the road. After that he considers the case in which the line branches into several roads. The method used by the author is a graphical one, and an extension of an older method described by him.—*Elek. Zeit.*, July 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Sparking in Switches.—RUSSELL.—A summary of an investigation of Paterson and himself, in which he reaches the following conclusions: The spark at break ought to be taken as a guide to the rating of a switch for use on direct-current circuits. The shape of the terminals does not make much difference in the length of the spark. The effect of increasing the speed of the break above that ordinary used is small. The effect of a double break is to make the length of the sparks the same as the length of a spark with the same current at half the voltage. The difference in the length of the spark when copper, steel or zinc is used is not great. In small double-break switches for use on circuits of 200 volts and upwards, when the trailing spark just fails to bridge the air-gap, the factor of safety is 2. In double-break switches for large currents under the same circumstances, the factor of safety is greater than 2.—Lond. *Elec. Times*, July 31.

REFERENCES.

German Central Station.—GASSNER.—An illustrated description of the central station of Ludwigshafen. It contains at present three 400-hp generating units, while space is available to increase the capacity to 6,000 hp. The three-phase current system is used, the voltage of transmission being 3,000; in transformer stations the voltage is reduced to 125, and from there the secondary network is supplied. The direct-current for traction is generated in the power house itself, the direct-current dynamos being mounted on the same axle with the three-phase generators.—*Elek. Zeit.*, July 24.

Earthing.—PROCTOR.—His Mun. Elec. Ass'n. paper in full, together with a detailed account of the discussion which followed, abstracts of which have been noticed recently in the Digest.—Lond. *Elec.*, August 1.

High-Tension Switches.—SCHUH.—An illustrated article on switches and circuit breakers of a Swiss company, in which the well-known horn arrangement is used.—*Elek. Zeit.*, July 24.

WIRES, WIRING AND CONDUITS.

Electric Resistance of Insulators.—ROOD.—An account of measurements of the internal resistance and of the surface resistance of glass, quartz, mica, ebonite and guttapercha. The following values of the internal resistance refer to a plate of one square cm. in area and a thickness of one mm.; quartz, 885,000 ohms; guttapercha, 18,500,000 ohms; ebonite, 55,000,000; mica, 133,000,000. The following values of the surface resistance refer to "one surface of one sq. cm. between the terminals;" commercial window glass, 1,590,000 ohms; cobalt glass, 22,000,000 ohms; mica, 50,760,000; guttapercha, 432,000,000; quartz, 521,000,000; ebonite, 2,000,000,000 ohms. These values are to be regarded only as first approximates.—*Am. Jour. Sc.*, August.

ELECTRO-PHYSICS AND MAGNETISM.

Cremieu's Experiments.—CREMIEU.—A description of some further experiments made to meet the objections raised against his results. He claims to have experimental certainty that in the electric convection experiment a charge is carried along with its ponderable support; that only this charge acts upon the magnetometer, and that no appre-

ciable loss of charge occurs during the movement. The convection apparatus consists of a horizontal ebonite disc 244 cm. in diameter, with a sector of gilt micanite. The observations showed impulses upon the magnetic system whenever the sectors were charged or discharged, and usually in the sense in which a permanent deflection could be theoretically expected. Sometimes, also, there was a slight permanent deflection in the expected sense, but both impulses and deflection died away as the apparatus continued working. No quantitative relation between the amount of charge and the deviation could be detected. On reversing the disc with uncharged sectors, the deflections also occur occasionally, but in the opposite sense. The sectors were charged and discharged during every revolution.—*Comptes Rendus*, July 7; *L'Eclairage Elec.*, July 26; abstracted in Lond. *Elec.*, August 1.

Magnetic Effect of Electric Displacement.—WHITEHEAD.—An account of an experimental investigation. Maxwell assumes that the phenomenon of polarization in a dielectric consists of an actual propagation or displacement of charge in the direction of polarization, and that the "displacement current" has the same magnetic effect as a conduction current, so that in the case of a condenser the magnetic effect in the neighborhood, incident upon any change of charge, would be due to the combined influence of the current in the charging wires and the displacement current in the dielectric. Such a direct magnetic effect of the displacement has, however, never been satisfactorily observed. The author has made a long series of experiments. In principle his method is to subject a piece of a dielectric to an alternating electric field, and also to an alternating magnetic field, the directions of the two being at right angles in space; to adjust the phases of the two to give the maximum effect of the displacement-current reaction against the magnetic field, and to look for motion of the dielectric in a direction perpendicular to the plane including the directions of the electric and magnetic fields. He used four different forms of apparatus, in each of which a block of dielectric was hung rigidly at each end of a light beam which was suspended horizontally on a quartz fiber attached at its center. The phase of either the electric or the magnetic field on one block being 180 degrees from that on the other, the other field having the same phase for each block, the reaction of the displacement current on the magnetic field would be opposite at the two ends of the beam, causing a couple to act on the fiber suspension. He made a great many experiments, the results of which are different, but the mass of the evidence of his research is against the presence of the magnetic effect of electric displacement in an amount given by Maxwell's theory. He intends to continue his investigation.—*Am. Jour. Sc.*, August.

Luminous Gas Surrounding a Wire.—BORGMANN.—A description of the peculiar light effects observed in a vacuum tube traversed from end to end by a fused-in wire, one end of which is free, the other is attached to a secondary pole of an induction coil; the other pole of which is put to earth. By putting a condenser between the tube and the coil, the intensity of the luminosity can be varied. He describes in detail the various phenomena noticed when the tube is joined to the positive or negative pole, and when the poles of the coil are joined by a spark-gap or not. The tube being attached to the positive pole, and a spark-gap being inserted in parallel, the wire is surrounded by a series of luminous lenses, which are subject to magnetic deflection. Under the influence of a strong magnetic field at right angles to the wire, the lenses incline to the axis of the tube, and then begin to move slowly in the direction of inclination; after moving a short distance they disappear, but new ones appear in their original places, the process being repeated indefinitely.—*Phys. Zeit.*, July 1; abstracted in Lond. *Elec.*, August 1.

REFERENCE.

Terrestrial Magnetism.—The June number contains a brief mathematical paper by Nippoldt, on a theorem on the Fourier series and its application in geophysics; a note by Bauer on the magnetic disturbance during the eruption of Mount Pelee, Martinique; a note in German, by Haussmann, on a disturbing factor in suspension on points for measurements of declination; a note in German, by Hellmann, on Gilbert's De Magnets; an article, by Leyst, on Paul Passalkij and his last work on terrestrial magnetism; a biographical sketch of Christopher Hansteen; a sketch, by Cady, of the life and work of Max Eschenhagen, and an article, by Birkeland, on the proposed magnetic researches of the Norwegian polar station in 1902-3.—*Terr. Mag.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

The Financial Basis and Design of Electrolytic Metal Refineries.—PHILIP.—The first part of an article giving various statistical data and formulas. He has for many years collected and tabulated all the available details in order to elaborate a connected scheme, by means of which the task of designing an electrolytic refinery upon a sound financial basis might be successfully undertaken. The general method adopted has been to arrive at a formula for any given item of outlay, expressed in terms of all the variables involved, and then to insert in this a constant or constants obtained by calculation from all the available trustworthy figures hitherto published with regard to the particular item of outlay under consideration. He thus arrives at a formula stating that the cost of the power plant must be proportional to the product of the annual output of refined copper and the current density. The cost of offices in pounds sterling is given at 150 plus one-tenth the number of tons refined per year. The area of refinery buildings for a given yearly output is inversely proportional to the current density; the area in square feet is given as 30 times the ratio of the number of tons refined per year to the current density in amperes per square foot (the constant 30 is an average value, the value of this constant in six different plants varying between 21.9 and 31.5). The cost of works buildings in pounds sterling is given as 7.5 times the ratio of the output in tons per year to the current density in amperes per square foot. The power required varies directly as the output per year, and also directly as the current density employed. If gas engines and gas-producer plant is installed, and if the prime cost of supply and erection of this plant is $60 per horse-power installed, then the prime cost of the plant in pounds sterling including erection of gas engine and producer plant may be fairly given as 0.12 times the product of the output in tons per year and the current density in amperes per square foot.—Lond. *Elec.*, August 1.

Goldschmidt Process.—HOULLEVIGNE.—An account of experiments in which he prepared pure zinc with the Goldschmidt process in which iron oxides are reduced by means of aluminum. He recommends the use of at least 3 kgr. of substance, aluminum filings sifted, washed in petroleum essence and dried, and pure sequioxide of iron, free from sulphur and carefully dried, in excess of about 15 per cent. over the amount required for the chemical reaction, and crucibles lined with magnesia. If a less amount of the reagents is used, the iron remains suspended in the shape of separate globules, in a cavernous mass surrounded by small crystals of corundum. The addition of 20 per cent. of powdered cryolite to the mass increases the fusibility and raises the yield from 30 to 53 per cent. The best commercial ferric oxide contains 98.2 per cent of the oxide, but the slightest trace of sulphur is very obnoxious. There is even greater difficulty in obtaining pure aluminum free from fatty matter. The best way is to wash the filings with petroleum essence and then dry them in a sand-bath, at 150 degrees, for several days.—*Jour. de Phys.*, May; abstracted in Lond. *Elec.*, August 8.

A Thermochemical Constant.—F. W. CLARKE.—A brief abstract of an A. A. A. S. paper. He studied the heats of combination of organic compounds, and after reducing to the gaseous form throughout, under uniform conditions of temperature and pressure, he finds that by the application of a definite formula, nearly every equation yields a constant which is identical in value with the neutralization constant of strong acids and gases. The average in 66 cases is 13,773 small calories. The conclusion is reached that the absolute heat of formation, from gaseous, dissociated atoms, of the aliphatic hydrocarbons and their simpler derivatives, is proportional to the number of atomic linkings within the molecule. In this calculation every linking counts as one, and single, double or triple unions between carbon atoms become identical as regards their thermal value. The conclusion is revolutionary, but it satisfies the equations which are otherwise indeterminate. The preliminary paper contains 66 verifications of the new law.—*Science*, August 22.

Exactness of Faraday's Law.—T. W. RICHARDS.—A brief abstract of an A. A. A. S. paper. He showed that Faraday's law holds with great accuracy for aqueous solutions and ordinary temperatures. The weight of silver deposited in the "porous cup voltameter" of Richards and Heimrod, was compared with the weight deposited by the same amp.-hours from a solution of argentic nitrate in fused sodic and potassic nitrates at 300 degrees; it was found that the weights were identical within the limits of error of the experiment, about 0.005 per cent. This investigation places Faraday's law among the most exact and invariable of the laws of nature.—*Science*, August 22.

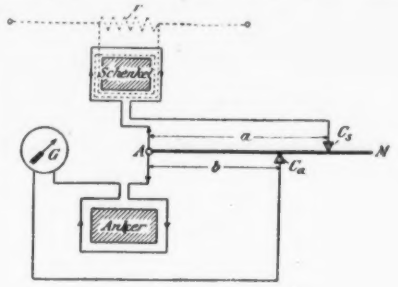
REFERENCES.

Purification of Water by Ozone.—An illustrated description of the Siemens & Halske experimental plant, for purifying water by ozone, near Berlin, which has been noticed before in the Digest.—*Sc. Am. Sup.*, August 23.

Electrolytic Production of Metals.—KOEHLER.—A paper read before the Canadian Mining Institute, on the electrolytic production of metals, with special reference to copper and nickel. A large number of processes are discussed.—*Sc. Am. Sup.*, August 23.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Zero Method for Magnetic Measurements.—ROTH.—An illustrated description of a method which he has used for determining the stray field of direct-current dynamos. The arrangement is shown in the adjoining diagram for a shunt-wound dynamo; one winding is placed around one pole and another around the armature. *G* is a



MAGNETIC MEASUREMENTS.

galvanometer, *Ca* and *Cs* are contacts sliding along the wire *AM*; the resistances of this wire from *A* to the sliding contact points are *a* and *b*, respectively. A resistance, *r*, is connected in parallel with the exciting winding of the field poles, which is represented by dotted lines. When the machine has been excited, and the exciting current is suddenly interrupted, the disappearing magnetic flux, in the pole piece and the disappearing smaller flux in the armature, induce two e. m. fs. in their circuits. These two e. m. fs. are opposed to one another at the point *A*. If the rate of the decrease of the two fluxes is the same, the ratio of the two e. m. fs. is equal to the ratio of the two fluxes. For a certain relation between the positions of the two sliding contacts, there is no current, flowing through the galvanometer; this is the case when the ratio of the fluxes equals the ratio of $w + a$ to b, where w is the resistance of the winding around the polepiece together with the conductors to the wire *AM*. The resistance, w, may be eliminated if a position of the two sliding contacts is first found for which there is no current through *G*; the resistance of the wire *AM* from *A* to the two sliding contracts may be *a* and *b* respectively; then the position of both sliding contacts is changed, but in such a way that there is again no current through *G*, the resistances which were in the first case *a* and *b*, may now be *A* and *B*. Then the ratio of the two fluxes equals the ratio of $a - A$ to $b - B$. In reality, in making this test, the needle of the galvanometer in the first measurements is deflected to one side, and in the second to the other side; it cannot be made to remain at rest; this is because the coefficient of straying increases with increasing excitation. The measurement must be limited to a sufficiently short time interval.—*Elek. Zeit.*, July 24.

REFERENCE.

Testing the Magnetic Properties of Iron.—EPSTEIN.—A rather sharp polemical answer to a recent communication of Benischke, on the regulations of the Association of German Electrical Engineers for testing the magnetic properties of iron.—*Elek. Zeit.*, July 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Party Lines.—ZABEL.—An illustrated article on the construction of party lines.—*Tel. Mag.*, July.

Wireless Telegraphy.—COLLINS.—The first part of an illustrated article, in which he gives a review of the theory of electric resonance and its relation to syntonic wireless telegraphy.—*Sc. Am.*, August 23.

Wireless Telegraphy.—COLLINS.—An illustrated description of Braun's system.—*Elec. Rev.*, August 16.

MISCELLANEOUS.

REFERENCES.

Goldschmidt Process.—GOLDSCHMIDT.—A long, illustrated paper on his well-known process of getting high temperatures by means of aluminium, which has been repeatedly noticed in the Digest.—*Zeit. d. Oest. Ing. u. Arch. Ver.*, August 1.

HOSPITALIER.—A biographical sketch, with portrait, of Edouard Hospitalier, who will be the next president of the International Society of Electricians in Paris.—Lond. *Elec. Rev.*, August 8.

Dusseldorf Exhibition.—HOFFMANN.—A profusely illustrated description of the exhibits of hauling and hoisting machines, tramways, elevators, etc., for mines. Also an illustrated description of an electric hoisting machine of Schuckert & Co.—*Glueckauf*, August 9.

New Books.

THE ELECTRICAL CATECHISM. 533 Plain Answers to 533 Practical Questions About Electrical Apparatus. Compiled from the regular issues of *Power*. New York: Hill Publishing Company. 210 pages, 246 illustrations. Price, $2.00.

Text-books, arranged in catechism form, that is as a series of questions and answers, are especially attractive to some persons. While the present volume is not original in treatment nor particularly successful in exposition, readers of this class will find in it a great deal of useful information. Pains have evidently been taken to adapt the language to the understanding of the beginner, and the questions are as a rule well chosen. The subjects treated give an outline of the generation and distribution of electric light and power, including alternating currents. The general principles of dynamo and motor construction are given, and methods of wiring, measuring instruments and other apparatus are explained and illustrated.

THE ELECTRIC ARC. By Hertha Ayrton, M. I. E. E. (London). New York: "The Electrician" Series, The D. Van Nostrand Company. 479 pages, 146 illustrations. Price, $5.00.

This book is so interesting that it reads like a novel. Yet it is a careful scientific story of experiment and deduction. It is probably the most complete scientific publication on the phenomena of the voltaic arc that has yet been published.

There are twelve chapters in the book. The first outlines the general appearance and phenomena of the arc. The second gives, in 77 pages, a short history of the arc and its laws. The bibliographic list of communications, extending over the nineteenth century, at the end of this chapter, include 111 references. The third chapter deals with the phenomena presented when the arc is first struck. The fourth chapter deals with the arc voltage as a function of the length and of the traversing current. The rule is enunciated that at constant current strength between solid carbons in the permanent state a straight-line law connects the voltage with the length.

Chapter V considers the crater, its area and other properties. The rule is stated that with silent constant-current arcs a straight-line law connects the voltage with crater area.

Chapter VI deals with the power of D. C. arcs employing solid carbons. Two very important conclusions are stated; viz.: (1) That at constant current and constant regime, a straight-line law connects the power with the length. (2) That at constant length and constant regime, a straight-line law connects the power with the current. As a consequence of these rules a rectangular hyperbole connects voltage with length when the current is variable, but after the permanent state has been attained.

Chapter VII discusses the P. D. between each carbon and the arc, and the results of experiments with inserted test electrodes.

The relations between the arc and its circuit, including the generator are ably discussed in Chapters VIII and IX.

Hissing arcs and their various phenomena are treated of in Chapter X. Much experimental evidence is adduced in support of the conclusion that the hissing of an arc is due to what might be described as its boiling over the edge of the crater and spilling over the sides beyond. There seems to be no escape from the conclusion, and it has important bearings upon all the phenomena of the arc.

Chapter XI considers the light emitted by the arc. It is stated that the light emitted in any direction is roughly proportional to the area of crater visible from that direction. It is also stated that owing to luminous absorption by the arc the most efficient arc would be obtained with infinitely thin carbons infinitely near together. For constant length of arc efficiency increases with the current.

The twelfth chapter is 60 pages in length and deals with the vexed question of the resistance of the arc versus its c. e. m. f. Most ob-

servers have taken the position that nearly all the p. d. between the carbons of an arc is due to c. e. m. f., and only a relatively small residue is due to fall of potential due to resistance. A mass of experimental data are here adduced, leading to the opposite conclusion; namely, that the arc has a relatively high resistance in its vapor and in its mist, and that the observed voltage at carbons is nearly all due to resistance, and only a small residue is attributable to an independent c. e. m. f. This seems to be a reasonable conclusion. There probably must be some thermo-electric e. m. f. in an arc; but this would be liberally estimated by allowing a volt for it. The remainder is reasonably accounted for by fall of potential through gases.

A supplementary biographical list of 35 references concludes the book, together with an index of 19 pages. Every page of the book bears evidence of careful work and an effort to preserve an unbiased attitude in a subject that is full of experimental difficulty and much debated.

There is room for a second volume on the phenomena of the alternating-current arc, which are treated at lesser length in this volume.

The writer is to be congratulated on the clearness of style and voluminous experimental data found in the book. It is an invaluable volume to the electrical engineer interested in arc lighting, and it is a very fascinating work to the general electrotechnician. Not the least interesting is the first page, with its beautiful dedication to Mme. Bodichon.

Die Elektrolyse des Wassers Ihre Durchfuhrung und Anwendung. By Viktor Engelhardt. Halle a. S.: Wilhelm Knapp. 117 pages, 90 illustrations. Price, 5 marks.

This publisher, the most important publisher of electrochemical works in Germany and probably in the world, is starting to print at regular intervals a series of monographs on applied electrochemistry, of which this is the first volume. These promise to be of considerable interest and value, as each is to be written entirely on one subject, by an authority on that subject. There is much valuable information lost to the world in patent literature and in the experience of those who have made special investigations in one subject. While the patents themselves are accessible, yet it frequently happens that in actual practice, processes are carried out slightly differently from the way they are described in the patents. In this series of volumes, each is to be a full, detailed report of the present state of that art, and of its development. It is not the intention to make them a general compilation of the present state of the arts as a whole, but they are intended rather as special reports, each complete in itself. It is intended that they shall include commercial data, costs and descriptions of installations, or in general they are to treat of applied or industrial electrochemistry as distinguished from the purely theoretical subject matter, but the latter is not to be excluded entirely, as the importance of theory in such applications is also recognized. The editor of the whole series is Mr. Engelhardt, who is at the same time the author of this first volume; he is the chief engineer and chief chemist of the Austrian branch of the Siemens & Halske Company. We are pleased to add that like in most of Knapp's books, the usual type used by the rest of the world is to be employed in this series also, as distinguished from that objectionable, specifically German type, to which some of the less progressive German publishers still adhere. An effort is also being made to have these volumes translated into English.

The present volume, which is on the electrolysis of water, begins with a short historical introduction, followed by what he calls the constants, namely, the numerical data concerning oxygen and hydrogen and water, as used in its electrochemical decomposition. Then follows the main part of the book, which consists of illustrated descriptions of the various processes that have been patented or used in the industrial electrolysis of water. These are divided into those in which porous diaphragms of non-conducting material are used; then, those in which the diaphragms are entirely non-conducting and not porous, in which cases the current goes around them, the object of the diaphragm being to prevent the gases from mixing; and, lastly, those in which perforated conducting separators are used. Then comes a department in which are described the processes in which the mixed gases are gathered—that is, those in which no attempt is made to separate the components—and, lastly, a few processes in which the oxygen alone is gathered. The next chapter is on the applications, including the cost of installations, the operating costs, consumption of anodes and comparison of the electrolytic with the purely chemical or purely physical methods, the applications of the gases for producing high temperatures, lighting, soldering, power, blasting, ballooning, etc. The book is concluded with a number of tables, such as for the corrections for temperature and barometer, the tension and the conductivity of the electrolyte. Lastly, there is a short index of authors and inventors referred to in the book.

If all the subsequent volumes deal with their respective subjects as thoroughly as this one does, the series promises to become one of great value to the electrochemist, and it is to be hoped that arrangements for translating them into English will prove successful.

BOOKS RECEIVED.

Alternating-Current Machines. By Samuel Sheldon, Ph. D., and Hobart Mason, B. S. New York: D. Van Nostrand Company. 259 pages, 184 illustrations. Price, $2.50.

Lehrbuch der Praktischen Physik. By Dr. F. Kohlrausch. Leipzig: B. G. Teubner. 810 pages, illustrated. Price 8.60 marks.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Indiana Electrical Association, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

Intermational Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

The Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

Pennsylvania State Street Railway Association, Secretary, John Ruth. Next meeting, York, Pa., Sept. 10, 1902.

U. S. Military Telegraph Corps, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury, Vt.

Carborundum Manufacture at Niagara.

With the prospect of more power in the near future, the Carborunudm Company, of Niagara Falls, New York, is soon to build a new three-story brick building which has been long contemplated. Cramped for room, a new office building was erected by them but a short time since. This company uses at present about two thousand electrical hp, and takes current from each of the two phases for its electric furnaces. When current is shut off from a furnace where it has been continuously applied for from twenty-four to thirty-six hours, it is applied to another furnace. The usual length of time the current is shut off is nine or ten minutes. The transformer attendant at the Carborundum works always notifies the electrician on the

switchboard at the power house when a load is to be taken off or put on. In putting on a new furnace, the load increases gradually until the mass comprising the furnace has become thoroughly heated and the load practically uniform.

One of the switchboard troubles was formerly due to leaking current, and was overcome by open work in the specially built board, to prevent "creeping."

When a furnace has been cooled off and its contents assorted, traces of graphite are often found. This fact led Mr. Acheson to experiment along that line, and finally to manufacture graphite on a large scale, in a large building adjoining the works of the Carborundum Co., on the upper Niagara, a short distance above the power house.

Power Plant of the Buffalo Forge Company.

The economy of electric power distribution is well illustrated in the plant of the Buffalo Forge Company. In the six shops comprising its plant, and occupying an entire block in the central part of the city, electric drive is employed exclusively. Formerly Niagara power alone was used on the drive, and the boilers used simply for testing and for heating the plant. The plant now installed is of sufficient size to enable it to utilize at all times the full steaming capacity of its boilers. The power thus developed is used in connection with that received from the Falls.

The boiler plant consists of a battery of two 125-hp return-tubular Erie City boilers, supplied with induced draft. Furnishing power to the shops, and supplementing the Niagara power are two 100-kw, direct-current General Electric dynamos, each direct-connected to a 12 and 20 by 14-inch horizontal tandem compound Buffalo engine, running non-condensing. A 30-hp air compressor, belted to a single vertical engine, drives the pneumatic hoists and small pneumatic tools throughout the shops. The 40-hp generator used in lighting the offices completes the equipment.

The offices and shops are heated by the hot blast system. By means of steam-driven fans the air is drawn through the steam coils of the heater and distributed through galvanized iron pipes or ducts to all parts of the various buildings. By this arrangement a uniform temperature of 60 degrees in the shops and 70 degrees in the offices is maintained with great economy. The heaters, except in extremely cold weather, require only the exhaust steam from the power plant and their own engines. The cost of running both power plant and heating plant together is thus practically no greater than running either one alone, since the engine is capable of converting only about 10 per cent. of the calorific value of the steam into work.

Besides providing for the above uses, considerable boiler power is required at times for the tests. These comprise running and power tests of engines, from the smallest fan engines to 300-hp, high-speed compound engines, tests of the various types of belted exhaust fans and blowers, and of electric and fan units direct connected to high-speed engines. The demand for power in these tests is very irregular. While on occasions it may reach as high as 300-hp, the usual peaks are about 150-hp, and the average load about 80-hp. The average load on the boilers is about 300 boiler hp, with peaks of about 450 boiler hp, or loads from 120 per cent. to nearly 200 per cent. of the rated boiler hp.

Of particular interest in this connection is the great increase in capacity and ultimate economy in operation of the boiler effected by the use of high intensities of draft. The induced draft plant consists of a special 90-inch full housing bottom, horizontal discharge exhaust fan exhausting from the smoke breeching, and discharging into a short stack. It has an overhung blast wheel driven by a 4½-in. x 5-in. direct-connected, single vertical engine, capable of running the fan at speeds varying from 300 to 600 r. p. m., and producing corresponding drafts of from one-half to two and one-fourth inches of water, with the flue gas at a temperature of approximately 500° F. A Foster regulator automatically governs the speed of the engine to produce the proper draft to maintain a constant steam pressure in the boilers.

By this arrangement demands for steam are readily met to double the rated capacities of the boiler, without noticeable decrease in pressure and with no other attention than to proper firing and water supply. Nor does this high rate of driving lower the efficiency of the boiler as one might naturally suppose. With a ratio of heating surface to grate surface of 45 to 1, which is usual in boilers made at the present time, the loss of heat in the flue gas at double the rated performance is only about 4 per cent. more of the total heat of the coal than at the rated capacity, while the radiation loss remains practically constant for all rates of driving, and is, therefore, reduced from about 12 per cent. to nearly 6 per cent. of the total heat of the coal. This shows the total efficiency of the boiler to be about the same. If the maximum capacity of the plant were increased by doubling the number of boilers instead of increasing the performance by increased rate of combustion, twice as much coal would be required in keeping up steam throughout the 24 hours a day. This, in plants having irregular loads for 10 hours a day, amounts to a considerable portion of the coal bill, which we see is greatly reduced by resorting to higher rates of driving at the peaks and employing fewer boilers.

In the instance of such a manufacturing establishment as the above, it is seen that the power developed by utilizing at all times the full capacity of the boiler plant will cost far less than central station power. Each additional electric horse-power within the capacity of the boiler will require but from two and one-half to three and one-half additional pounds of coal per hour. The additional cost of such power will, therefore, be only about $.0044 per hp-hour for coal, or only about $.0053, including cost of maintenance and interest on cost of engines, dynamos, power-house, etc. When generated in connection with the heating plant the cost of the additional power will be that of maintenance, etc., or $.0008 to $.0010 per hp-hour, plus $.0005 for fuel.

Oil Switches.

The increasing use of high voltages has naturally led to many problems in switching, and in the solution of those the oil switch has come to the front. Of this type of switch we illustrate one of the latest forms made by the General Electric Company.

The form of switch shown is electrically opened and closed by hand. All of the live parts are supported from a single base or frame which constitutes the top of the switch, and the complete switch may be attached to any appropriate support as a single piece of apparatus. The mechanism consists of one or more metal contact pieces, depend-

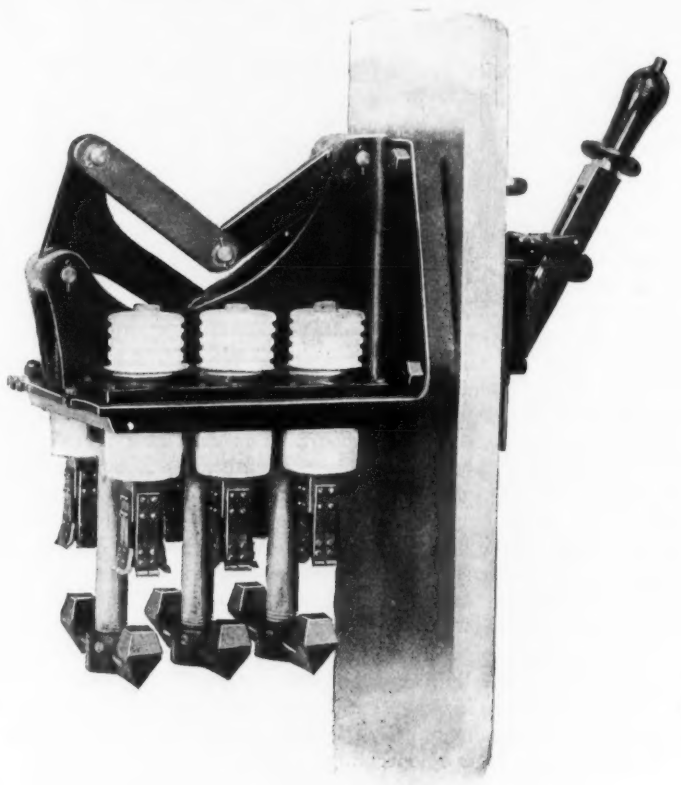


FIG. I.—OIL SWITCH, ELECTRICALLY OPENED, CLOSED BY HAND.

ing upon whether the switch be single, or double, or triple pole. Each contact piece is carried upon a rod of specially treated wood. The rod or rods are connected to a crosshead, which, when operated by the system of levers, moves in a vertical plane. The clips with which the contact pieces make connection are supported from the frame by porcelain insulators thoroughly insulating all live parts. The switch is closed when the contact pieces are in their upper position,

and in opening the switch these contacts drop into the lower portion of the oil can. The clips, contact pieces, and all exposed live parts are completely submerged in oil when the can is in place. No leads are introduced through the oil can, therefore there is no opportunity for leakage and no difficulty in the removal of the can.

This switch is not designed to rupture loads under emergency conditions, such as a short circuit immediately beyond the switch on the load side, which can exceed 5,000 kw, single-phase, or 8,500 kw, three-phase. They should not be mounted directly upon the panel for use on circuits which under emergency conditions can exceed 2,500 kw, three-phase, or 1,500 kw, single-phase. Conditions may exist which will render the use of this type of switch mounted directly upon the panel permissible in connection with circuits which under emergency conditions may somewhat exceed 2,500 kw, but such use should not be attempted without inquiring as to the advisability of it under the conditions contemplated. For service in connection with circuits which under emergency conditions can exceed 2,500 kw, three-phase, or 1,500 kw, single-phase, single-pole switches are generally used, each pole being placed in a separate fireproof compartment. These are arranged in groups of two, three and four single-pole switches of the remote controlled type, operated by one handle and suitable for mounting in cells.

To make the switch automatic and to have it perform the functions

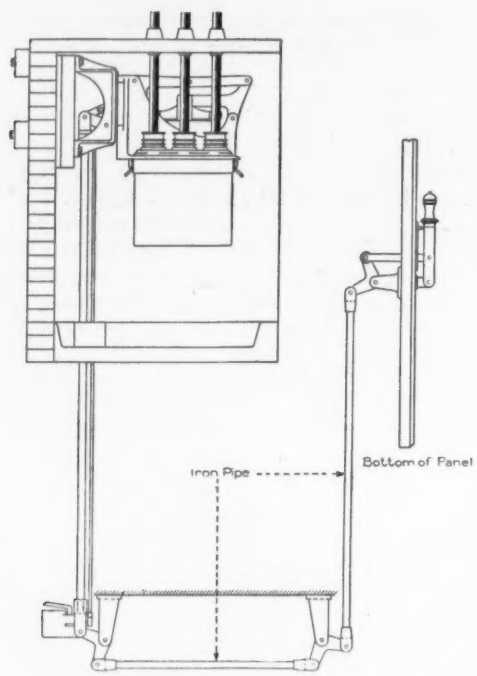
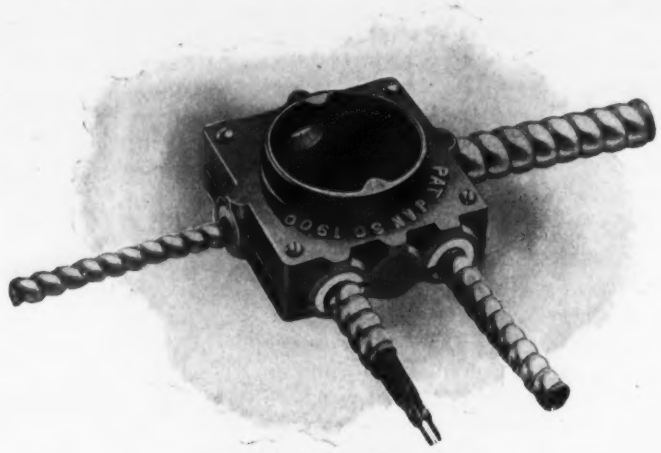


FIG. 2.—ARRANGEMENT OF SWITCH ON BACK OF OPERATING BOARD.

of an automatic circuit breaker, two forms of tripping mechanism are employed. The type selected depends upon whether the switch is installed directly upon the switchboard or in cells at a remote point. The first, or switchboard tripping mechanism, is shown in Fig. 1. It consists of a set of coils upon the face of the board (the edges of which are visible on the cut) operating armatures which actuate a release catch on the link connecting the switch and the handle. The tripping coils are energized from the secondaries of current transformers connected in series with the main circuit of the switch. When the switch is thrown open automatically by means of the tripping coils, the operating handle on the face of the board remains closed, the link moving forward through the handle. This movement serves to indicate that the switch has automatically opened. Fig. 2 shows diagrammatically the arrangement of this type of switch mounted on the back of operating panel.

Junction Box.

The accompanying illustration shows a new adaptation of a side-wall junction box that will be of interest to electrical contractors because of its great convenience in wiring. It is the usual type of sidewall box manufactured by the Sprague Electric Company for use with the flexible products of that company, in its well-known line of interior conduit. The use of the lead bushings, furnished by the company, obviates the necessity of having different sizes of boxes for different sizes of conduit, as one box is thus able to take a variety of sizes of conduit, from

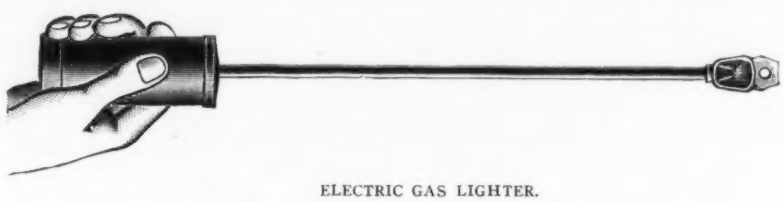


SIDE WALL JUNCTION BOX.

one-half inch down, or a variety of conduit, cable and cord. Reference to the illustration will give a clear idea as to how this is accomplished.

Gas Lighter.

The accompanying illustration shows a gas lighter manufactured by Mr. Wm. Roche, 42 Vesey Street, New York. It is made entirely of metal, is about 24 inches long, and weighs 1 lb. The dry cell enclosed in the handle is 4½ inches long and 1¾ inches in diameter. The current supplied by this cell is sufficient to render incandescent



ELECTRIC GAS LIGHTER.

the small platinum coil at the upper end of the rod, and the gas coming in contact with the incandescent metal is immediately ignited. The platinum igniter is enclosed by a wire screen to prevent injury. It is stated that with ordinary use this lighter will give from 1,000 to 1,500 ignitions from one cell of battery.

A New Pull Cluster.

A new standard pull-cluster has recently been introduced by Harvey Hubbell, Bridgeport, Conn. It is slightly different in de-

PULL CLUSTER..

sign from his old cluster, in that the socket cap is a part of the cluster center, which not only makes it more ornamental in appearance, but

more substantial and mechanically correct. The chain on each socket is about four or five inches long, connecting in the center with the coupling rosette. From the bottom of this rosette a single chain, about 3 feet long, is hung. One pull on this chain will turn on the lights, the next extinguishing them. A pull down will turn on all the lights; a pull to one side will turn on one or more.

All parts are carefully made and adjusted. The action is smooth and bright. The clusters are furnished with a shade holder only, or with a brass covering tube, shade holder and canopy, complete, or with a solid brass stem, shade holder and canopy. Mr. Hubbell is prepared to furnish different lengths of chain and stem to accommodate the different heights of ceiling. The cluster is made in two three, four, five and six-light, fitted in either Edison, Thomson-Houston or Westinghouse base, and of any finish desired.

This cluster is a decided improvement over the old, in which the socket was merely attached to the regular cluster. The idea of each individual light of the cluster being under separate and direct control is entirely new. The clusters and sockets combined are most convenient in this respect, and make the handiest arrangement possible. They are of perfect workmanship, and have stood the severest test.

New Universal Milling Machines.

The Becker-Brainard Milling Machine Company, of Hyde Park, Mass., have placed upon the market a new line of plain and universal milling machines from new designs and patterns. These machines embody many new features, special attention being given to strength, power and rigidity in order to meet the demands of modern milling machine practice. In the universal machines, the spindle is connected with the change-feed mechanism by a train of three-spur gears, thereby eliminating the usual feed pulleys and belt, giving positive gear drive necessary for heavy and rapid cuts.

The change-feed mechanism is a novel feature, and obviates loss of time in changing gears. The feed is obtained and driven by the

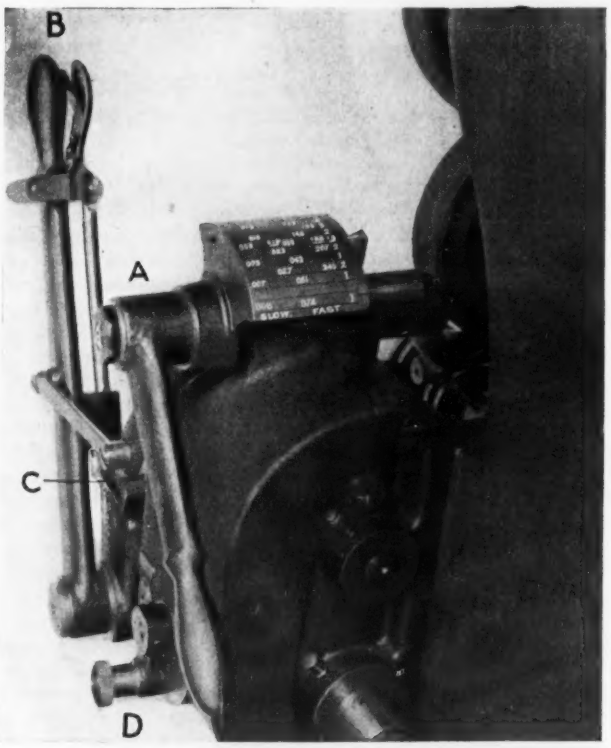


FIG. 1.—MILLING MACHINE.

main spindle through a train of three-spur gears on the back of the machine, which drive two nests of change-feed gears in the column. By compounding the gears in the upper nest, the various changes of feed are secured, giving, with the quick change in the gear case on the outside of the machine, 20 changes of feed for each spindle speed, Levers, operating the change-feed mechanism, are conveniently located on the side of the feed box, and all changes may be made by the operator without stopping the machine or changing his position. The changes are made by the simple movement of the levers, bringing them into position indicated on the index plate, which has each feed plainly marked on its surface, showing the exact position to which the levers must be brought to give a desired feed per revolution of the spindle. For example, suppose a feed at the rate of seventeen-thousandths per revolution of the cutter is to be obtained, the lever *B*, as shown by the cut, is placed in the notch marked 3 on

FIG. 2.—MILLING MACHINE.

the lower quadrant *C*, and then the lever, *A*, is brought to the line marked 3, opposite the space .017 on the index plate. The quick-change lever, *D*, on the lower side of the feed-box is then moved to the hole marked slow, and the desired speed is obtained. Should it be desired to increase the feed, move lever, *A*, so as to point to the line at 3 prime, marked with dash below, on the index plate, and .019 is obtained. If the feed is to be decreased, the lever *B* is moved to notch 4 on the quadrant *C*, and .013 is obtained. When the fast feeds are desired, the quick-change lever, *D*, is thrown into the hole marked "fast," and the same operation performed as described above.

The power is transmitted from the change-feed mechanism through the telescopic shaft connecting, by gears, the longitudinal, transverse and vertical feeds, which are reversed by a lever on the side of the knee within easy reach of the operator. Both transverse and vertical feeds are operated and controlled by a lever, located on the side of the knee, which, when central, disconnects both feeds; and when thrown into position for one feed, it is impossible to connect the other.

Another important feature is a clutch arrangement enclosed in the hubs of the hand wheels, which operate the vertical movement of the knee and cross movement of the carriage. When either the knee or carriage have been set to the required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand-wheel, thereby preventing any accidental change from their fixed position, and also preventing the hand-wheels from revolving when the automatic feeds are thrown in.

The knee, which is of the box type, provided with a telescopic elevating screw, makes holes in the floor unnecessary, and allows the machine to be placed regardless of beams or foundations. The thrust of the screw is taken by ball bearings.

In designing these machines, the greatest care has been taken to secure the highest efficiency, together with accuracy and simplicity. Nevertheless, the parts are so arranged that they are within easy reach of the operator, and of sufficient strength to prevent breakage from undue strain. Metal distribution has been properly proportioned, the base being very solid, thereby absorbing vibration. The arm is a straight steel bar, so that any of the regular attachments can be placed in position without the necessity of removing the arm.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 5 to 5½ per cent., with very little business doing. The stock market was irregular although in the main it was strong, and the volume of trading done was large, attention being transferred rapidly from one group of stocks to another. The anthracite coal stocks were stronger on reports that there was a prospect of a settlement of the miners' strike. United States Steel stocks were strong, although they were not prominent in the market. Tractions showed more strength, Brooklyn Rapid Transit closing at 67¾, being a net gain of 1 point. Metropolitan Street Railway made a like gain, closing at 148, the lowest quotation being 147. General Electric made a jump of 9 points, the lowest quotation being 187½, and the highest 196; the shares sold aggregating 8,333. Westinghouse, both common and preferred, made substantial advances, the former 8 points and the latter 4, closing at 228 and 230, respectively. Western Union was active, and advanced to 97½, apparently on covering of shorts, though the idea that a combination of telegraph and telephone interests is under consideration found some believers. The stock closed at 95½, being a net loss of ⅜ point, as compared with last week's closing quotation. The sales aggregated 123,500 shares. Other closing prices were: American District Telegraph, 39, a net gain of ½ point; American Telegraph and Cable, 90, a net gain of ⅞, and American Telephone and Telegraph, 172½, a net loss of 1 point. Following are the closing quotations of Sept. 2:

NEW YORK.

	Aug. 26.	Sept. 2.		Aug. 26.	Sept. 2.
American Tel. & Cable.	—	94	General Electric	192	196½
American Tel. & Tel.	173½	—	Hudson River Tel.	—	—
American Dist. Tel.	39	—	Metropolitan St. Ry.	147¾	147½
Brooklyn Rapid Transit.	67¼	68¼	N. E. Elec. Veh. Trns.	⅞	¾
Commercial Cable	—	—	N. Y. & N. J. Tel.	—	—
Electric Boat	28*	25	N. Y. E. V. T. Co.	11⅝	—
Electric Boat pfd.	41*	40	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n.	2¼	2½	Western Union Tel.	95⅝	95½
Electric Vehicle	5½	5½	West. E. & M. Co.	224	229½
Electric Vehicle pfd.	14	14½	West. E. & M. Co. pfd.	—	230¼

BOSTON.

	Aug. 26.	Sept. 2.		Aug. 26.	Sept. 2.
American Tel. & Tel.	173½	171½	Western Tel. & Tel. pfd.	101	100½
Cumberland Telephone	—	—	Mexican Telephone	—	2¾
Edison Elec. Illum.	—	—	New Eng. Telephone	142½	143½
Erie Telephone	—	—	Westinghouse Elec.	—	113½
Western Tel. & Tel.	30	—	Westinghouse Elec. pfd.	110½	115

PHILADELPHIA.

	Aug. 26.	Sept. 2.		Aug. 26.	Sept. 2.
American Railways	50¾	51⅜	Phila. Traction	99¾	100
Elec. Storage Battery.	91	88	Phila. Electric	7⅛	8⅝
Elec. Storage Bat'y pfd.	89	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America.	8⅞	9¼	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Aug. 26.	Sept. 2.		Aug. 26.	Sept. 2.
Central Union Tel.	—	—	National Carbon pfd.	—	99¾
Chicago Edison	—	173	Northwest Elev. com.	—	36½
Chicago City Ry.	211	—	Union Traction	—	—
Chicago Tel. Co.	—	175	Union Traction pfd.	—	—
National Carbon	42¼	32½			

* Asked.

WESTERN UNION STOCK.—Our discrediting of the recent reports of telegraph consolidation is now echoed by the *Wall Street Journal*, as follows: "The rumors of a pending combination of telegraph and telephone companies are entirely discredited in quarters where there should be good information on such matters. It is probably true that a very strong pool is operating in Western Union. This pool was formed many months ago, but it is rather good opinion that attempts made heretofore, to advance the price have only been the means of bringing out long stock. The result, it is asserted, has been to place much more stock in the hands of the pool than was originally intended. The death of Mr. Mackay apparently led some people to believe that an obstacle to consolidation of Western Union and Postal Telegraph had been removed, and that something in this direction might be done. It is very probable, however, that this hope has not been well founded. There is no indication that the policy of the Commercial Cable Company, which controls Postal Telegraph, has undergone any change, and while nothing can be definitely stated in the absence of important interests in this company, any change in the measurably near future can hardly be looked for. Policies may change, but at present there does not seem to be any way of accounting for the activity and strength in Western Union, other than that it is the result of speculative activity."

MANHATTAN TUNNEL CAPITAL.—The stockholders of the Interborough Rapid Transit Company held a special meeting last week, when it was voted to increase the capital stock of the company from $25,000,000 to $35,000,000, the purpose of the increase being to raise funds to defray the expense of building the projected tunnel from Manhattan to Brooklyn, connected with the Manhattan underground system. One hundred thousand shares of stock will be issued at $100 par value.

CINCINNATI GAS AND ELECTRIC.—Attorneys are pushing the case against the Cincinnati Gas and Electric Company, through which it is sought to prevent the charging of two separate prices for gas. At the same time, efforts are being put forth to show that the recent reorganization and consolidation with the Edison Electric Company, necessitating a capital of $29,000,000, is illegal. The Superior Court is expected to hand down a decision in the matter in the near future.

DIVIDENDS.—The directors of the Chicago City Railway have declared the usual quarterly dividend of 2¼ per cent., payable Sept. 30. The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent., payable Oct. 1. The company gained 2,000 subscribers last month.

Commercial Intelligence.

THE WEEK IN TRADE.– Continued good crop prospects sustained trade activity in the northern half of the country, jobbing at the close of August being apparently at its height. At the South, the unfavorable cotton crop conditions have diminished as a result of hot, dry weather in the southern half of the belt. Prices of food products are tending downward. From this it is argued that the industrial situation should improve. There is little apparent change in the anthracite coal strike situation, though mine activity is increasing. The scarcity of coke in the Pittsburg and Chicago districts limits the supply of available pig iron and discourages future sales. The rail markets are active, the home plants being booked far ahead. Foreign iron is coming in freely. Large sales of structural material, plates and merchant bars are reported. Sales of hardware are active with jobbers, but the latter complain of slow deliveries. The business failures for the week ending August 28, as reported by *Bradstreet's*, numbered 140, as against 181 the week previous, and 188 the same week last year. Copper was very quiet and unchanged; the consumptive demand was very light, but prices, while unchanged, are in the buyers' favor. Standard is quoted 10.75 @ 11.15c. for spot to Nov.; Lake at 11.45 @ 11.60c. for Sept.-Dec., and electrolytic and casting stock 11.30 @ 11.40c. for spot to Dec.

ENGLISH THIRD RAIL WORK.—The system to be adopted between Newcastle-on-Tyne and its suburban points is the third-rail. The current, it may be said, will be purchased by the North-Eastern Railway Company from the existing station of the Newcastle Electric Power Company, whence it will be sent out at 6,000 volts, and afterwards transformed at the various substations to the working pressure just mentioned. The speed of the trains will be twenty-two miles per hour. There will be forty-seven trains on the different branches at one and the same time, each train having two motor coaches and one trailer coach. The total length of track is, with sidings, about forty-one miles. Of this, two miles (Newcastle Central Station to Heaton South Junction) is four-line track and thirty-five miles double track. The company intend to adhere to the compartment system for the coaches, as distinguished from the lateral seating used in American tramcars and on the London tube railways. Each train, under the new system, will carry 180 third-class and 24 first-class passengers, the latter being seated in the trailer car, which is placed in the center of the train between the two motor coaches. The trains will be equipped with Westinghouse brakes, and the whole train can be controlled from any driver's compartment. Adequate precautions will be taken against fire and all other sources of danger. The quayside branch, for goods traffic only, which has very steep gradients, ranging from 1 in 27, and 1 in 31 up to 1 in 140, will be worked by electric locomotives, which are to pull trams of 150 tons weight, and to be able to stop or start on any part of the branch. The gradients on some of the other branches are moderately severe here and there, but can be readily negotiated by the electric trains.

THE KEYSTONE ELECTRIC COMPANY, Erie, Pa., has just received an order from the Smith Premier Company, of Syracuse, for machinery and supplies for the latter company's plant to the amount of $64,000.

RECENT SALES OF TRIUMPH APPARATUS.—The Triumph Electric Company, of Cincinnati, O., notes the following recent sales of dynamos, motors, and complete plants: The Krell-French Piano Company, Newcastle, Ind., one 200-kw, engine type, direct connected generator and 56 motors from 5 to 40 hp, aggregating 520 hp in motors; The Wooster University, Wooster, O., two 100-kw, and one 50-kw, engine type, direct connected generators; the Kanawha Valley Traction Company, Charleston, W. Va., two 125-kw, belted type of generators; Eastern Kentucky Asylum for the Insane, Lexington, Ky., one 75-kw, engine type, direct connected generator and a 15 and 10 hp motors; U. S. Printing Company, Cincinnati, one 100-kw, engine type, direct connected generator; Nordberg Mfg. Company, Milwaukee, Wis., one 100-kw and a 60-kw belted generator; The Globe Wernicke Company, for its Cincinnati plant, one 200-kw belted generator and fifteen motors in sizes of 5 to 30 hp, aggregating 380 hp in motors; for the same company at its Norwood plant, one 200-kw, engine type, direct connected generator and twelve motors of 5 to 65 hp, capacity aggregating 530 hp, in motors; The Armour Packing Company, for its New Orleans plant, one 75-kw, engine type, direct connected generator; The Water Works and Electric Light Company, Norwood, O., two 100-kw, engine type, direct connected generators; The Kenmare Dry Coal Company, Minneapolis, Minn., one 80-kw, belted generator; E. H. Hewins, Boston, Mass., two 30-kw, engine type, direct connected generators; The Gardner Electric Light and Power Company, Gardner, Mass., one 50-kw, engine type direct connected generator; P. Derby & Co., Gardner, Mass., one 25-kw, engine type, direct connected generator; The John A. Dunn Company, Gardner, Mass., one 30-kw, belted generator; Ralph S. Hopkins, Seattle, Wash., one 50-kw, belted generator; Northern Pacific Railway Company, in its St. Paul shops, one 50-kw, engine type, direct connected generator and one 15 hp, one 7½ and one 10 hp motor; The Calvert Lithographing Company, Detroit, Mich, one 75-kw, engine type, direct connected generator; The Beals & Selkirk Company, Detroit, Mich., one 30-kw, direct connected generator; The Brady Union Stock Yards Company, Atlanta, Ga., one 30-kw, engine type, direct connected generator; The Alexian Hospital, St. Louis, Mo., one 50-kw, engine type, direct connected generator; The Eclipse Electric Company, St. Louis, Mo., one 25-kw, engine type, direct connected generator; The James H. Curran Elevator Company, Cincinnati, 21 elevator motors; F. Woodlar & Co., Cleveland, O., one 25-kw, belted generator; W. P. Callahan & Co., Dayton, Ohio, 15 lighting machines of 7½ to 10 kw capacity; The Buckeye Iron and Brass Works, Dayton, O., twelve machines of 7½ to 12½ kw capacity; The Charter Oak Stove and Range Company, St. Louis, Mo., one 100-kw, engine type, direct connected generator, two 35 hp, one 25 hp, two 10 hp and two 5 hp motors.

EXIDE BATTERY DEPOTS.—The constantly increasing number of electric vehicles equipped with batteries of Exide accumulators, manufactured by the Electric Storage Battery Company, of Philadelphia, has prompted this company to anticipate the convenience of its customers by opening a number of "Exide battery depots" in different localities for the purpose of maintaining the batteries of its manufacture in the best possible manner, and securing to the owners the same care and supervision of their equipment they would receive at the company's main factory. These depots are fully equipped and are placed under the charge of experienced battery men, competent to advise in all matters pertaining to the operation of Exide batteries, and to generally supervise the treatment received in the way of charging, etc. The Exide battery depots already announced have been located in New York, at 148 West Eighteenth Street; Philadelphia, 250 North Broad Street; Buffalo, 200 Pearl Street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Olive Street, and Detroit, 101 Woodward Avenue. Users of the Exide battery are requested to consult with the engineer in charge of the nearest station when desirous of securing advice or new parts for their equipment.

ENLARGING POWER PLANT.—The Oroville Gas Electric Light & Power Company, Clarence M. Smith president, will make an addition to its electric power plant. The same capitalists control both the light and power company and the local water company. The Engineering Offices, San Francisco, are doing the engineering work on the new plant. According to a contract between the two companies, the same water that later supplies the town of Oroville is used to produce power at Thompson's Flat under a head of 240 feet. The present plant consists of a 120-kw General Electric single-phase generator belted to a water wheel. The new plant which is now in course of construction will be equipped with a 200-kw Stanley three-phase 2,200-volt generator which will be direct connected to Pelton water wheel.

STORE LIGHTING AT DULUTH, MINN.—A contract has just been completed in Duluth, Minn., for the installation of 3,000 lights in one of the largest department stores in the Northwest. The show case and window lighting is of the latest and most efficient style. There will be a five-panel, white Italian marble switchboard and two Ideal engines, direct connected to General Electric machines; also one motor-generator, to be used as an auxiliary in case of any trouble to the plant. The motor-generator will be run by 500-volt street railway current. This work will be installed by the Northern Electrical Co., of Duluth.

THE VILTER MANUFACTURING COMPANY, builders of Corliss engines, etc., Milwaukee, Wis., has recently closed contracts with the following parties: Midland Rice Milling Company, Midland, Tex., 17 x 42 engine; Adler & Obendorf, Chicago, Ill., 16 x 36 engine; Estate of Anson Eldred, Milwaukee, Wis., 16 x 30 engine; T. J. Gardner, Las Animas, Colo., 10 x 15 x 30 tandem compound engine; Menasha Paper Co., Menasha, Wis., 16 x 36 engine; Menasha Paper Co., for Ladysmith, Wis., 20 x 42 engine; Saginaw Valley Traction Company, Saginaw, Mich., 32 x 60 engine; Wm. Hellman & Co., Milwaukee, Wis., 6 x 24 engine.

THOS. POTTER, SONS & CO., of Philadelphia, manufacturers of oilcloth and linoleum, have adopted electric power distribution for the operation of their oilcloth and linoleum printing machines. the blowers used for drying oilcloth, elevators and other general work throughout their plant. They have recently purchased from the Westinghouse Electric & Mfg. Co., six induction motors, which will be added to their present equipment of one 160-kw and one 120-kw, two-phase, 220-volt alternators and fifteen or twenty induction motors.

RIALTO BUILDING, SAN FRANCISCO.—Charles C. Moore & Co. will furnish the steam plant for the very complete electric system which is to be installed in the new Rialto Building at the corner of New Montgomery and Mission Streets, San Francisco. There will be two Babcock and Wilcox water tube boilers and two Ideal tandem-compound engines direct connected to Westinghouse generators. A high boiler pressure will be used which will be reduced at the engines by the use of Leslie's regulating valve.

DEMAND FOR CATALOGUES IN AMSTERDAM.—Consul Frank D. Hill, of Amsterdam, under date of July 24, 1902, writes that it would be advisable for exporters of iron, steel, coal, and electrical supplies to send catalogues to that consulate, as he intends to devote a room exclusively to circulars of American firms, folders of American railways, steamship lines, cable companies, etc. He has received many visits of late from people interested in the import trade, and they desire data in regard to United States industries.

NEW PLANT AT BOISE, IDA.—The new electrical power company at Boise is located one and three-fourth miles from the business centre. The equipment includes two double Leffel turbines with two generators for lighting and two for power, of Fort Wayne and Westinghouse make; Lombard governors are used. The station building is 40 feet by 70, and up to 700 hp can now be developed. The pole line is about completed. H. O. Pope is president; H. D. Pope, vice-president; M. D. Dobson, secretary.

KEYSTONE DYNAMOS AND MOTORS.—For the past eight years the Keystone Electric Co. has been manufacturing a line of direct current dynamos and motors, and is now in a position to supply machines up to 750 kw at 90 revolutions direct connected to Corliss engines. As The Keystone Electric Company it takes now a much more prominent position than heretofore, and is pushing vigorously for business. Its general sales agents are H. B. Coho & Co., Inc., 114 Liberty street, New York City.

TROLLEY WIRE FOR ENGLAND.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, 26 Cortlandt Street, has placed a contract with the John A. Roebling's Sons Company for sixteen miles of trolley wires to be utilized in the overhead construction of the Rotherham, England, electric traction system, the contract to which has been awarded to the British company.

BIG ENGINE FOR PHILADELPHIA.—Mr. A. J. DeCamp, general manager of the electric light consolidation, of Philadelphia, informs us that the Southern Electric Light Company, of that city, has made a contract with the Allis-Chalmers Co. for an 8,000 hp nominal engine, which will develop 12,000 hp in an emergency. The date of delivery is approximately one year from date.

THE JESSOP STEEL CO., of England, is building a large steel plant at Washington, Pa., in which electrical power distribution will be employed. The company has recently purchased a considerable amount of direct current apparatus from the Westinghouse Electric & Mfg. Co.

PLANT FOR SANFORD, N. C.—A new electric lighting plant of a capacity of 1,000 lights is to be put in at Sanford, N. C. T. M. Campbell, proprietor; O. McMahon, manager. Catalogues of material of all kinds are requested by Mr. McMahon.

BALL ENGINE ORDER.—An engine built by the Ball Engine Co., Erie, Pa., is being installed in the tobacco factory of R. & W. Jenkinson, Pittsburg, and will be used for electric lighting.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ending August 23: Argentine Republic—118 pkgs. material, $5,983. Antwerp—2 pkgs. machinery, $150; 116 pkgs. material, $1,260. Azores—1 pkg. material, $30. British Australia—21 pkgs. material, $55. British East Indies—45 pkgs. material, $988. British West Indies—208 pkgs. material, $1,233. Brazil—38 pkgs. material, $1,355; 22 pkgs. machinery, $5,036. Brussels—2 pkgs. material, $118; 3 pkgs. material, $50. Barcelona—1 pkg. material, $40. Bremen—3 pkgs. material, $20. Central America—71 pkgs. material, $1,384; 45 pkgs. machinery, $1.172. Copenhagen—4 pkgs. machinery, $291. Cuba—12 pkgs. material, $452. Dutch Guiana—8 pkgs. machinery, $5,425. Glasgow—9 pkgs. machinery, $1,435; 3 pkgs. material, $87. Havre—1 pkg. machinery, $75; 15 pkgs. material, $1.688. Hamburg—7 pkgs. machinery, $851; 39 pkgs. material, $1,367. Halifax Eng.—1 pkg. material, $42. Japan—30 pkgs. material, $2,800; 37 pkgs. machinery, $6,700. Liverpool—278 pkgs. machinery, $36,191; 27 pkgs. material, $1,398. London—59 pkgs. machinery, $705; 121 pkgs. material, $5,917. Manchester—17 pkgs. material, $433; 268 pkgs. machinery, $31,749. Mexico—3 pkgs. machinery, $255; 161 pkgs. material, $4,282. New Castle—11 pkgs. machinery, $1,946. Newfoundland—6 pkgs. material, $39. Nova Scotia—1 pkg. material, $14. Peru—107 pkgs. material, $5,365. Piræus, Greece—1 pkg. material, $50. Rotterdam—2 pkgs. machinery, $175. Southampton—251 pkgs. material, $2,500; 1 pkg. machinery, $71. Uruguay—4 pkgs. material, $162. Venezuela—6 pkgs. material, $228. The following is a list of the exports of electrical materials from the port of New York for the week ended August 30: Argentine Republic—15 pkgs. material, $1,413; 23 pkgs. machinery, $3,237. Antwerp—3 pkgs. material, $492; 5 pkgs. material, $712. Brazil—117 pkgs. material, $6,741; 6 pkgs. material, $3,171. Barcelona—53 pkgs. material, $3,000; 25 pkgs. material, $310. British East Indies—55 pkgs. material, $268; 10 pkgs. machinery, $2,491. Bordeaux—1 pkg. machinery, $500. British West Indies—4 pkgs. material, $43. Berlin—4 pkgs. machinery, $75. British Possessions in Africa—111 pkgs. carriage material, $15,900; 92 pkgs. material, $5,409. Chili—2 pkgs. material, $210. China—1 pkg. material, $75. Central America—19 pkgs. material, $504. Cuba—82 pkgs. material, $2,905. Vandiz—6 pkgs. machinery, $300. Dutch West Indies—6 pkgs. material, $109. Ecuador—6 pkgs. material, $265. Egypt—1 pkg. machinery, $30. Guernsey—1 pkg. material, $23. Havre—8 pkgs. machinery, $90; 23 pkgs. material, $383. Hong Kong—9 pkgs. material, $625; 310 pkgs. machinery, $9,987. Hamburg—11 pkgs. machinery, $704; 6 pkgs. material, $734. Japan—768 pkgs. machinery, $50,508; 105 pkgs. material, $10,734. Liverpool—308 pkgs. material, $1,380; 19 pkgs. material, $1,1222. Leicester—2 pkgs. material, $85. London—34 pkgs. machinery, $1,120; 77 pkgs. material, $5,807. Leeds—1 pkg. material, $90. Marseilles—2 pkgs. material, $100. Marlian—19 pkgs. machinery, $1,512. Mexico—20 pkgs. machinery, $1,300; 38 pkgs. material, $997. Neuss—11 pkgs. machinery, $3,500; 2 pkgs. material, $14. Port Talbot—1 pkg. material, $24. Peru—27 pkgs. material, $836. Philippine Islands—192 pkgs. material, $2,327. Riga—8 pkgs. material, $500. Rotterdam—2 pkgs. machinery, $75. Siam—9 pkgs. machinery, $577. Southampton—176 pkgs. material, $2,580. Strassburg—3 pkgs. material, $300. St. Petersburg—22 pkgs. material, $5,600. San Domingo—3 pkgs. machinery, $4,300. U. S. Colombia—16 pkgs. material, $3,750; 4 pkgs. material, $93. Venezuela—20 pkgs. material, $285.

MEXICAN LIGHTING PLANT.—A project is on foot with a view to the consolidation of the interests of three fair-sized Mexican electric lighting plants and the building of another. The principal plant is located in the city of Tampico, and is owned by the Tampico Electric Light Company. Its present capacity is about 500 hp. There are 150 arc and 3,000 incandescent lamps. The equipment was mostly furnished by the General Electric Company. Another plant is situated in the city of Victoria, and furnishes energy for 50 arc and 2,000 incandescent lights. Its horse-power is 250. The generators are of General Electric build. The third plant is a three-phase one, and furnishes lighting power for the city of Linares, and lights 50 arcs and 1,500 incandescents. Its capacity is 200 hp. The General Electric Company furnishes the generators. The two first-mentioned plants are operated by steam, and the Linares one is both water and steam. It is proposed to rebuild and considerably extend these plants, and to construct a water-power one of 200-hp capacity (1,500 incandescent lights) for supplying the city of Montemorelos with power for lighting purposes.

LIGHTING PLANT FOR COSTA RICA.—The American Supply and Construction Company, 120 Liberty Street, has secured a contract through the United Fruit Company, of Boston, whose New York offices are at 24 State Street, for the steam end of a 200-kw plant, which is to be built for lighting purposes at Port Limon, Costa Rica. The three boilers, 100-hp water tube, will be built by the Sterling Company. The engines will be two 150-hp tandem-compound, center-crank machines, to be furnished by the Harrisburg Foundry and Machine Works. These engines will be belted to General Electric generators. Each engine will be thus connected to two generators of 50 kw. The engines will run in oil, and will be individually set in asbestos-lined steel casing, bricks not being resorted to in view of the unsuitability of the soil and the question of space. The condensing apparatus will be supplied by the Wheeler Condenser and Engineering Company, of 120 Liberty Street. The heater outfit is to be of Wainwright type. The order for the piping has not yet been let. Shipment will be made about Nov. 1.

ELECTRICITY IN GERMANY.—A cable dispatch from Berlin, of August 31, says: Nearly all industrials were strong last week. Irons advanced from two to six points, and coal shares advanced varyingly, some increasing 11 points or more. Electricals were irregular. Shares of the Schuckert Electrical Company, of Nuremberg, recovered strongly because the annual meeting of the stockholders of this company brought no further disappointments, and a group of Berlin banks is arranging to give the company financial assistance by taking the securities of its various undertakings, which are at present unsalable. This arrangement involves a partial alliance with the Berlin Allegemeine Elektricität Gesellschaft.

THE ELECTRIC SUPPLY AND CONSTRUCTION COMPANY, of Zanesville, Ohio, was recently incorporated with a capital stock of $10,000. The officers are as follows: Gilbert Snyder, president; J. B. Rhodes, vice-president; A. T. Brennan, secretary; A. W. Evans, treasurer; R. J. Moore, manager, and S. M. Winn, general counsel. The directors are Gilbert Snyder, J. B. Rhodes, A. T. Brennan, R. J. Moore and S. M. Winn. The company proposes to do contracting of all kinds of electrical construction, in addition to carrying a complete line of electric supplies to supply the wholesale as well as the retail trade.

ACTIVITY IN WEST VIRGINIA.—Mr. John L. Livers, Buckhannon, W. Va., has contracts to install and operate within the next 60 days the following Warren alternators, furnished by the Rumsey Electrical Manufacturing Company, of Philadelphia: One 120-kw, Grafton Gas and Electric Company, Grafton, W. Va.; one 120-kw, Keyser, W. Va., Electric Light Company; one 90-kw, Davis, W. Va., Electric Light Company; one 60-kw and complete plant at Parsons, W. Va.

THE AMERICAN INSULATING MACHINERY COMPANY, OF PHILADELPHIA, has recently completed and shipped some heavy-winding machinery to John A. Roebling's Sons, Trenton. The New Haven office of the American Insulating Machinery Company has been closed, and Mr. Thomas S. Reed, who was in charge of that office, is no longer connected with the company. All business will hereafter be handled through the Philadelphia office.

AMERICAN SUPPLIES FOR SOUTH AFRICA.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., Havemeyer Building, has secured a contract for furnishing considerable supplies for the city of Durban, S. A., municipal electric traction system, which will be filled in the American market. The contract calls for a quantity of trolley cord and brake attachments for 30 cars, replacing devices for 50 cars, etc.

OTIS ELEVATOR IN ENGLAND.—It is announced by cable from London that the English branch of the Otis Elevator Company, Limited, has absorbed the business of R. Waygood & Co., Limited, the leading firm of elevator makers in England. The latter company acquires by its agreement with the Otis firm full rights to manufacture from the American patents and to use all licenses of the parent concern.

THE EUREKA ELECTRIC COMPANY, of Chicago, has just obtained a contract from the city of Chicago for furnishing telephone apparatus for the fire-alarm telephone service. This speaks well for Eureka apparatus, as this is the first independent telephone outfit to be used by the city of Chicago, which has previously used American Bell apparatus exclusively.

BRILL TRUCKS FOR JAPAN.—The J. G. Brill Company, of Philadelphia, has just secured a contract through the American Machinery and Export Company, of 120 Liberty Street, New York, for several car trucks for the Osaka, Japan, electric traction system. Another order for twenty-five is pending for the same road.

WESTINGHOUSE TURBINE ORDER.—Westinghouse, Church, Kerr & Company have secured a contract for the supply of a 400-kw Westinghouse steam turbine, which will be installed in the paper mills of the S. D. Warren Company, Cumberland, Me.

GENERATING PLANT BIDS WANTED.—Bids are asked until Sept. 3 for engines, generators, etc., at the New York Reformatory, Elmira. G. L. Heins is State Architect, Albany, N. Y., and Charles F. Howard is president of the board.

WESTINGHOUSE MOTORS FOR QUEENSLAND.—The Queensland Government railway shops are about to be equipped with several alternating-current motors, built at the East Pittsburg shops of the Westinghouse interests.

General News.

THE TELEPHONE.

SAN BERNARDINO, CALIF.—The City Trustees of San Bernardino have advertised the sale of the telephone franchise applied for by C. F. Guthridge, of Los Angeles.

LOS ANGELES, CALIF.—The new exchange of the Home Telephone Company in this city will be one of the largest ever installed in the United States. There will be switches for 18,000 subscribers or double the number now in operation with the Sunset Company.

SAN FRANCISCO, CALIF.—The Sunset Telephone Company is reducing its rates in competition with the new Pomona Valley Telephone Union. The price of individual telephones, which is now $4 per month, is to be reduced to $2.50 for business houses and $2 for residences. The 10-party rate, now $1.50 per month for private houses, will be reduced to $1.00.

TALLADEGA, GA.—The Home Telephone Company of Talladega has been sold to the Bell Company. The local exchange will be rebuilt.

VALDOSTA, GA.—The board of trade of Valdosta has decided to appoint a committee to endeavor to prevent the establishment of a second telephone system in the city unless the company shall absorb the old company. The new concern is the Bell Company. W. A. Bisbee, of Savannah, is principal owner of the independent company.

AUGUSTA, GA.—The Strowger Telephone Company of Augusta is making long distance connections towards the north and the south by special arrangement with the numerous independent lines in this section and expects to soon have connection with at least 1,000 miles of long distance lines.

VICTOR, IDA.—The Rocky Mountain Bell Telephone Company will extend its line from Teton City to Victor, a distance of 50 miles.

CHICAGO, ILL.—Within the next month the Illinois Central Railroad expects to have its new telephone circuit established between Chicago and Omaha

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company has leased one of the Kerfoot buildings in the heart of the city for a central telephone exchange.

ATWOOD, ILL.—The Atwood Mutual Telephone Company, lately incorporated, will be ready for business in October. The switchboard has a capacity of 25 bell drops and 60 series drops. The company has 150 subscribers.

FLANAGAN, ILL.—The Flanagan & Dana Telephone Company has installed the Stromberg-Carlson system. A new switchboard is to be put in, and there will be about 15 party lines to provide for, besides some 30 village telephones.

CHICAGO, ILL.—The Automatic Electric Company has leased from the Lewis Institute directors the six-story brick structure at Van Buren and Morgan Streets, which it will maintain as an automatic telephone and switchboard factory in connection with its previously established factory on Washington Boulevard. Immediate steps are now being taken for the location of between 7,500 and 8,000 telephones of the secret service, automatic type in the business heart of the city.

ALEXANDRIA, IND.—The Central Union Telephone Company has decided to increase the size of its plant and the efficiency of its service in this city.

INDIANAPOLIS, IND.—The Modoc Telephone Company commenced business June, 1902. It operates a 100-drop board and is gaining subscribers rapidly. It has 16 miles of local circuit and 16 of toll line.

EVANSVILLE, IND.—The City Council passed an ordinance, Aug. 19, asking the Cumberland Telephone Company to quit doing business in the city on Aug. 25. The Board of Public Works will ask for new bids for a franchise.

INDIANAPOLIS, IND.—The Amboy Home Telephone Company, of Amboy, Miami County, capital stock $5,000, and the Cowan Rural Telephone Company, of Cowan, Delaware County, capital stock $4,000, have been incorporated.

NEW HAVEN, IND.—The New Haven Telephone Company has been placed in the hands of a receiver. W. L. Mallering being appointed receiver. The exchange is a small one and has not proved profitable from the start. The plant will be sold and then greatly improved.

MISHAWAKA, IND.—The local council has granted a franchise to the Home Telephone Company, an independent corporation, despite the strong opposition. The Bell Company at once announced a reduction in rates to residences of $3 and $5 a year. Business service is also to be reduced.

INDIANAPOLIS, IND.—S. P. Sheerin, of this city, was before the State tax board in the interest of the new local and long distance telephone companies asking that the assessments as fixed by the board be reduced to what he called a fair figure. The assessment of the local companies was fixed by the board at $550,000, which was an increase of $289,000, or 110 per cent. over last year. The assessment of the New Long Distance Company was fixed by the board at $193,000, an increase of $132,000, or 110 per cent. These were said to be exorbitant. Several other companies were heard from.

EVANSVILLE, IND.—The movement to establish a municipal telephone plant in this city is about to fail and the city administration is fearing a legal entanglement. The city wants to award a franchise to the best bidder, but the Cumberland Company, the present occupant of the field, asserts that its franchise can be successfully defended. The city must first free itself and establish a right to grant a franchise before other companies will bid. Bids thus far submitted provide that the city must dispossess the Cumberland Company. If this matter was settled the city could make a satisfactory contract. It is claimed that the Cumberland's franchise has expired and that it is the duty of the council to revoke it. To revoke it would be a recognition of its validity and the power to revoke might fail. The Cumberland is willing to enter into a new contract, but only with preferred terms, not nearly so favorable as other bids.

CEDAR FALLS, IA.—The farmers of this city are making a raid on the Cedar Valley Telephone Company and are ordering telephones faster than the company can supply them.

DENISON, IA.—The Crawford County Telephone Company has been incorporated recently with $50,000 capital. The Stromberg-Carlson system will be used, with switchboard capacity of 200 town and 20 farm lines.

SIOUX CITY, IA.—William Bowen, agent of the Stromberg-Carlson Company, whose application for a telephone franchise has been some time in abeyance, is again endeavoring to obtain it. The franchise, if granted according to the provisions of the ordinance introduced, will be given to William Bowen personally.

HOPKINSVILLE, KY.—The city of Hopkinsville has accepted a proposition from the Cumberland Telephone Company whereby this company will furnish long distance connections and reduce the price of the service. This settles the question of competition in this town, at least, for the present.

LOUISVILLE, KY.—The Home Telephone Company of Louisville has just secured a controlling interest in the New Albany, Ky., Home Telephone Company, which has been in operation since 1896. The New Albany company has a capital of $100,000. The Louisville company will build connections with the New Albany company.

SHELBYVILLE, KY.—The town of Shelbyville, Ky., will sell, during the month of September, a local telephone franchise. The Cumberland Company is already operating in the town. It is said that the Louisville Home Telephone Company is back of the movement. The new franchise will forbid consolidation with any other company on the part of the owners of the new franchise.

BALTIMORE, MD.—The International Telephone Company has recently purchased the charters of several concerns in Maryland, among them the Maryland Telegraph and Telephone Company. The International will begin the building of lines through the State and will make a maximum charge of two cents per call.

McINTOSH, MINN.—A local telephone system is to be put in by Mr. Anton Jenson and will be ready for business September 1. Stromberg-Carlson apparatus is installed.

JOPLIN, MO.—The Mineral Belt Telephone Company, which includes the exchanges in Carthage, Joplin, Webb City, Cartersville and Oronogo, with all connecting lines, has been sold to a company headed by Theodore Gary, of Macon, Mo., for $250,000. The company will be reorganized with a capital stock of $200,000 with 6 per cent. dividend guaranteed. The new company will also issue $150,000 ten-year bonds, bearing interest at 5½ per cent. This issue has been underwritten by a Macon syndicate. The new company will at once expend $75,000 in improvements.

NEW LISBON, N. J.—The Farmers' Telephone Company, H. M. Black, president, has 25 miles of toll line now being built and will use the Kellogg system.

SERGEANTSVILLE, N. J.—The Merchants' and Farmers' Telephone and Telegraph Company has been formed; capital $10,000. Incorporators: William Strouse and Wesley D. Bodine, Sergeantsville, N. J.; Charles M. Reading, Frenchtown, N. J., and William C. Gebhardt, Clinton, N. J.

TRENTON, N. J.—Nearly 200 telephones have been installed and connected by the new Interstate Telephone Company at Trenton, and it is expected that almost another hundred will be in operation early in September. The new building is expected to be ready for occupancy by October 1.

HOPEWELL JUNCTION, N. Y.—The East Fishkill Telephone Company has just started business with 50 subscribers, and about 25 miles of local circuit. The Hudson River Telephone Company will extend its lines to Hopewell Junction and connect with those of this company.

GASTONIA, N. C.—An effort is being made to construct rural telephones in Gaston County, N. C. Gus Shannon, of Gastonia, is interested.

SHELBY, N. C.—The Boiling Springs Telephone Company of Cleveland County, N. C., has been incorporated with $1,000 capital, with D. J. Hamrick and others as stockholders.

WILMINGTON, N. C.—The Columbus Telephone Company has a switchboard at Chadbourn and one at Whiteville. Forty-four telephones are now in operation and further extensions are planned. The capital stock is $5,000.

MANCHESTER, OHIO.—The Manchester Telephone Company, incorporated in May, 1902, has Western Electric apparatus—a drop board with 125 subscribers. The company is about putting in several miles of lines on both sides of the Ohio river.

PITTSBURG, PA.—The Postal Company is now preparing to construct new through trunk lines all along the Pennsylvania railroad system, from New York to Pittsburg and from Washington to Buffalo. Within the next month work will be started on the stringing of eighteen copper wires between Philadelphia and New York. Twelve wires will be strung from Philadelphia to Pittsburg, and four will be required on the line along the Northern Central and Philadelphia and Erie branches.

ST. MATTHEWS, S. C.—The St. Matthews Telephone Company has obtained its charter. The capital is placed at $1,500. L. M. Able is secretary and treasurer.

CHESTERFIELD, S. C.—The Chesterfield Telephone Company is ready to receive its charter. Officers have been elected as follows: president, J. A. Welsh; vice-president, Dr. D. T. Neal; secretary and treasurer, T. P. Mangum. Long distance lines will be erected.

NASHVILLE, TENN.—The new service of the Cumberland Telephone and Telegraph Company in this city has gone into effect.

CLARKSVILLE, TENN.—The city council of Clarksville has granted to R. B. Crane, of Toledo, Ohio, and others a franchise to build a competition telephone system.

NASHVILLE, TENN.—A charter has been granted to the District Telephone Company of Shelby County, Tenn., with a capital of $100,000. Those interested are E. Howard, J. Compton, W. T. Gentry and others of Shelby County.

WAXAHACHIE, TEX.—The Ellis County Independent Telephone Company, just incorporated, has $100,000 capital, and has switchboard capacity of 800 drops at Waxahachie and 400 at Ennis; 323 subscribers at the former and 285 at the latter place. Toll lines to Corsicana and Waco will be built in the near future.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will at once start building its extension from De Lamar to Jordan Valley, Idaho.

FREDERICKSBURG, VA.—A long distance line is being built between Fredericksburg and Rappahannock, which will give connection with nearly 200 exchanges in the State of Virginia.

CLAREMONT, VA.—The Claremont Telephone Company has just commenced a line from Surry Court House to this place. Charters to Waverly and Petersburg have also been secured. The Bell system will be used. G. H. Woods is president.

WINCHESTER, VA.—The absorption of the Winchester Telephone Company by the United Telegraph and Telephone Company of Philadelphia is announced. R. T. Barton, of Winchester, was elected president. The company controls 30,000 telephones.

MADISON, WIS.—The Dane County Telephone Company has been formed, with $100,000 capital, for the purpose of building farm lines. It has an Ericsson switchboard of 1,500 drops and 3,500 capacity, and 1,490 subscribers. Extensions are projected.

LEEDS, WIS.—The Leeds Farmers' Telephone Company, which commenced operations in 1901, has been recently incorporated. Three small switchboards have been used, but are to be changed to a larger one this fall. There are about 10 miles of toll line and extensions are projected.

OTTAWA, ONT.—The Canada Atlantic Railway has about completed a private metallic circuit telephone line between Ottawa and Depot Harbor, on the Georgian Bay. The system will be one of the most complete and up-to-date private systems possessed by any company. In its construction, covering a distance of 262 miles and return, about 534 miles of copper wire have been used. The object in inaugurating such a service is to relieve the telegraph lines and afford better communication with the elevators of the company, with which there is much detailed business transacted.

SALT LAKE CITY, UTAH.—The Telluride Power Company has been granted a franchise for 25 years to maintain a telephone system in Salt Lake County.

ELECTRIC LIGHT AND POWER.

SKAGWAY, ALASKA.—The Northwest Light & Power Company, C. E. Shepard, of Seattle, Wash., president, has an electric light plant at Skagway, Alaska, and gas works at Everett, Wash.

MALVERN, ARK.—The Malvern Light & Power Company was formed in 1898 with $8,000 capital. The owner, C. W. Turner, operates T-H. and General Electric, arc and incandescent system of 580 lights.

RED BLUFF, CALIF.—The Northern California Power Company, H. H. Noble, president, is building an extension of 50 miles to Willows. The company employs Westinghouse apparatus.

SAN JOAQUIN, CALIF.—The San Joaquin Power Company has been incorporated with a capital of $300,000, by Alto Weiss, E. A. Beck, W. G. Kerckhoff, A. C. Balch and H. W. A. Melveny.

SAN JACINTO, CALIF.—Messrs. Roach and Chambers are the officers of the electric light plant from whom it takes its name. It was organized in 1897 with $15,000 capital. The Westinghouse system is used.

SANTA PAULA, CALIF.—The Santa Paula Electric Company has begun work on the plant which is to furnish lighting here. A General Electric alternating-current plant is to be put in. Mr. C. C. Teague is secretary.

RICHMOND, CALIF.—The Richmond Light and Water Company, H. E. Crocker, president, was organized November, 1901, with $25,000 capital. It has 6 miles of circuit, 1,200 incandescent and 50 enclosed arc lights, and uses crude oil for fuel.

OAKLAND, CALIF.—The Suburban Electric Light Company distributes current from long distance lines of the Standard Electric Company and Bay Counties Power Company to 19,000 incandescent lights of 16-cp. Mr. C. A. Jeffery is secretary.

SAN FRANCISCO, CALIF.—The South Yuba Water & Power Company has received a report from Engineer Price, who has been examining the Oregon Hill property. It is proposed to drive tunnels and utilize the water supply for a large electric power plant.

IDAHO SPRINGS, COLO.—The Cascade Electric Company was formed in 1901 with $65,000 capital stock. It has 21 miles of circuit furnishing 2,200 16-cp and 30 arc lights, with five electric motors.

ORLANDO, FLA.—The Orlando Water and Light Company was formed in 1901, with $50,000 capital. J. M. Cheney is secretary. The General Electric system is used, one dynamo furnishing 2,000 lights.

ATLANTA, GA.—A. H. Cox, representing the Atlanta Electric Company, has made a proposal to the city to furnish electric power for lights at $30 per hp per year, the city to furnish its own wires, poles, etc.

COLUMBUS, GA.—The Coweta Power Company, with $150,000 capital and the privilege of increasing it to $1,000,000, has applied for a charter at Columbus. The company proposes to develop large water power on the Chattahoochee river, furnish light and power, and also to erect and operate manufacturing plants. Geo. J. Baldwin is one of the corporators.

ST. ANTHONY, IDA.—The new electric light company at St. Anthony has ordered another generator, which will double the capacity of the plant.

BOISE, IDA.—The Highland Valley Power Company near Boise has started work on its new dam on the Boise River. The dam will be 18 feet high and 240 feet long.

WEISER, IDA., has voted to issue $40,000 in bonds for an electric plant and water works, chiefly for the latter. Thomas E. Kelly is mayor and Stewart H. Travis, city clerk.

CHRISMAN, ILL.—The Light and Water Company was formed early in the present year with $10,000 capital. Warren alternating-current apparatus furnishes 32 arcs and 600 16-cp incandescents.

BLUE MOUND, ILL.—The Blue Mound Electric Light Company was formed in 1901 with $4,000 capital. The Thomson-Houston alternating system is used. Mr. H. L. Ferguson is manager.

BELLEVILLE, ILL.—The Belleville Gas Light & Coke Company was sold Aug. 18 to a syndicate of Chicago and Cincinnati men. The purchase price is $240,000, but the purchasers assume an indebtedness of $60,000, making the actual consideration $300,000. The purchasers are represented by Mayor M. M. Stephens, W. S. Forman and L. D. Turner, Jr., of East St. Louis. The present capital stock of the company is $150,000. The shareholders receive $80 net cash for the stock, which has a par value of $50. It is the announced intention to reorganize the company and increase the capital stock to $350,000. It is stated that improvements will be made and the gas mains and the electric wires will be extended towards East St. Louis.

BLOOMINGTON, IND.—The People's Gas, Electric and Heating Company uses "Wood" apparatus. It has 24 miles of circuit and a coal gas outfit.

ROCHESTER, IND.—The Rochester Electric Light & Power Company, of Rochester, has filed articles of incorporation. J. E. Beyer heads the board of directors.

JONESBORO, IND.—The Jonesboro Light & Water Company, formed January, 1902, is a municipal plant. L. M. Pemberton is superintendent. The Fort Wayne system is employed. There are 26 arcs, 450 commercial lights.

CARTHAGE, IND.—The Carthage Electric Light and Power Company has $7,500 capital. It operates a water power plant, 17⅓ miles transmission. It has 1 400-kw General Electric dynamo, and the station is laid out for two more. The secretary is S. M. Strickland.

SUMMITVILLE, IND.—The Summitville electric light and water plant is now under construction, and will be owned by the municipality. When ready for operation it will represent an investment of $35,000 to $40,000, including the purchase of the present private lighting plant.

DURANT, IND. TERR.—The Durant Ice & Light Company, organized May, 1901, has a paid-up capital of $20,000. It has two dynamos of 60-kw each, Westinghouse system, and furnishes 1,200 lights. A. S. Smith is secretary.

BURNSIDE, KY.—The Burnside Electric Light & Power Company uses Bullock generators and has a power service of 1 10-hp, 1 2-hp and 30 fan motors. R. M. McCracken is general manager. The capital stock is $4,500.

ST. FRANCISVILLE, LA.—The town of St. Francisville has voted $10,000 water and electric light bonds.

BRIDGTON, ME.—The Bridgton & Harrison Electric Company, J. R. Sanborn, president, capital $50,000, has Westinghouse machinery and about 1,500 16-cp lights furnished by one 135-kw dynamo. It runs two motors.

LIVERMORE FALLS, ME.—The Livermore Falls Light & Power Company has an authorized capital stock of $100,000. Mr. E. Riley is president. The Edison system is installed; there are 15 miles of circuit and 5 motors are running.

HOUGHTON, MICH.—The Houghton County Electric Light Company has been organized with a capital stock of $1,300,000.

GRAND RAPIDS, MICH.—The Edison Electric Light Company is erecting a new building for a storage battery plant. In it will be placed 166 cells of an improved form of storage battery, with a capacity of 3000 ampere-hours.

SHAKOPEE, MINN.—The electrical plant here furnishes light and a small amount of power. There are 600 incandescents, 42 Nernsts and 34 arcs. This place is a good location for a central heating station, also for water works.

WHEATON, MINN.—The Wheaton Electric Light Company of Wheaton, Traverse County, has filed articles of incorporation. The incorporators are W. I. Gray, W. W. Bardwell, E. Le Vesonti, of Minneapolis, and F. W. Murphy and M. J. Jacobson, of Wheaton. The capital stock is $25,000.

GREENVILLE, MISS.—F. J. Butler, of Greenville, has been awarded the contract for a $36,000 electric power house at Jackson.

TUPELO, MISS.—The Tupelo Electric Light plant was organized in 1900 with $15,000 capital. This is a municipal plant, having between 1,400 and 1,500 lights, and using the Western Electric system. J. W. Hoyle is manager; E. W. Hawkins, superintendent.

NATCHEZ, MISS.—The Natchez Street Railway Company has purchased the plant of the Natchez Light, Power and Transit Company, paying $75,000 for the same. The last-named company has the contract for public lighting, which has seven years to run before it expires.

NEOSHO, MO.—The Neosho Electric Light Company, J. C. Geye, president, was organized in 1897 with $6,000 capital. The system is alternating, and there are 8 miles of wire.

CLAYTON, MO.—Articles of association of the St. Louis County Electric Company have been field in Clayton. The capital stock of the company is $50,000, one half of which is paid up. The shareholders are A. C. Einstein, of St. Louis, Charles J. Schnaus, of St. Louis, and O. J. Mudd, of Kirkwood. The main office of the company will be in Webster Groves.

HOOPER, NEB.—The Hooper Electric Light plant of which Mr. W. T. Martin is proprietor has $7,000 capital. It operates the Thomson-Houston system and has 500 lights.

SILVER CITY, NEB.—The New Mexico Light, Heat & Power Company was formed in 1900 with $30,000 capital. It operates 2 direct-connected dynamos, 6 miles of wire and 1,600 lights. E. L. Woods is president.

JERSEY CITY, N. J.—The United Electric Company of New Jersey has been awarded a contract by the Jersey City Water Supply Company to furnish light at the site of the new reservoir being built here.

ALBUQUERQUE, N. MEX.—J. J. Henery has been granted a franchise for the Electric Light, Power & Gas Company in Albuquerque. The new company will charge the following rates: Business houses, 15c. per kw-hour; residences, 20c. per kw-hour; 16 cp, 10 o'clock closing, $1.00 each per month; 16cp, 12 o'clock closing, $1.50 each per month; 16cp, all night, $2.25 each per month.

CHATEAUGAY, N. Y.—The Chasm Power Company, formed June 27, 1902, has $20,000 capital. The company is now constructing a dam and has already 2,500 lights.

BALDWINSVILLE, N. Y.—A light, heat and power company, with a capital of $100,000, has been organized at Baldwinsville, to do business in Baldwinsville, Lysander and Van Buren.

ROME, N. Y.—The Rome Gas, Electric Light & Power Company is one of the electric properties of which J. T. Lynch, of Detroit, Mich., is president. The company has three General Electric dynamos of 150-kw each.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company, organized in March, 1902, employs General Electric system and has 2 500-kw and 2 200-kw dynamos. Regular power service is furnished. S. P. Hunt is superintendent.

JAMESTOWN, N. Y.—Jamestown Lighting & Power Company, of Jamestown, has been formed to do public lighting in this city, the villages of Falconer, Celaron and Lakewood and in the towns of Ellicott and Buste in Chatauqua County. Capital, $100,000. Directors: Robert T. Paine, 2d, of Brookline, Mass.; Ernest S. Carr, of Jamestown, N. Y., and William H. Whitney, of Boston, Mass.

ADA, OHIO.—The Ada Water, Heat & Light Company, formed July 1, 1902, has a capital stock of $75,000. C. S. Ames is president.

COALTON, OHIO.—Directors of the Coalton Light, Power & Heating Company have decided to commence the construction of a plant at once.

NORTH AMHERST, OHIO.—A council committee has been inspecting a number of lighting plants and has decided to spend $8,000 for a municipal lighting plant.

PORTSMOUTH, OHIO.—Philip Hughes, of this place, has the contract for installing an electric lighting plant for the Munroe furnace of the Hill Coal Company.

GALLIPOLIS, OHIO.—The Gallipolis Electric Light Company has been incorporated with $10,000 capital stock by A. Clendenin, J. W. Clendenin, S. H. Eagle, C. H. D. Summas and E. D. Davis.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company has been incorporated with $250,000 capital stock under the laws of New Jersey, and has been admitted to do business in Ohio. W. A. Hinebaugh is at the head of the company.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company was formed January, 1902, with $15,000 capital. Westinghouse and Western Electric apparatus are used, furnishing 48 arc and 1,000 incandescent lights. J. H. Dodds is secretary.

CINCINNATI, OHIO.—The Cincinnati-Newport-Covington Light and Traction Company has a capitalization of $10,000. The lighting and power system is General Electric; the railway system Westinghouse. The former has 25,000 16-cp lamps and 600 arcs; the latter 70 miles of track. E. Harrow is the chief engineer.

COLUMBUS, OHIO.—The Providence Engineering Company of Cleveland has submitted prices on three horizontal cross compound condensing engines at a cost of $29,250. The company was the only bidder for furnishing equipment for the proposed municipal plant. Legal proceedings are holding up the question of the lighting plant, and new proposals will be called for when the suits are settled.

EL RENO, OKLA.—The El Reno Light & Power Company was formed January, 1902, with $150,000 capital. H. Lassen is president and J. A. Masters, manager. It has 10 miles of arc circuit, 6 miles of incandescent and 50 alternating enclosed lamps. Three thousand lights are now wired in.

GOLD HILL, ORE.—The Condon Water & Power Company has been incorporated at Gold Hill, with a capital of $100,000, by C. R. Day, W. F. Hunter and F. S. Smith.

ROSEBERY, ORE.—The Douglas Electric Company has a water power plant and General Electric system. Three miles of circuit and about 100-hp of 8, 16 and 32-cp lights. F. W. Benson is secretary.

CHARLESTON, S. C.—The Charleston Light and Water Company has filed notice of an increase of capital stock from $500,000 to $1,000,000.

GEORGETOWN, S. C.—The Georgetown Electric Company was organized October, 1891, with $50,000 capital. It is a light and power plant supplying 1.600 incandescent and 44 arc lights, besides 30 fans. There are 16 miles of copper wire. H. L. Chandler, of Philadelphia, is president.

FORT MILL, S. C.—The Catawba Power Company is constructing near Fort Mill what will be one of the largest dams in the South when completed. The estimated cost will be $1,000,000. Four thousand eight hundred horse-power is what the company expects to develop. Two cotton mills have already contracted for power with which to run their machinery.

HOUSTON, TEX.—The Houston Lighting and Power Company, organized December, 1901, has $275,000 capital stock and employs the General Electric system. The plant is three-phase alternating, managed by W. H. Chapman. There are 12,000 lights of 16-cp, 425 street arcs and 275 commercial arcs.

PARIS, TEX.—The Paris Light & Power Company was reorganized November, 1901, and the capital stock increased from $120,000 to $200,000. H. L. Baker is the secretary. The plant furnishes electricity, gas and steam heating, the General Electric system being installed throughout. The Paris Transit Company is owned by the same parties.

LOGAN, UTAH, has voted $65,000 in bonds for a municipal electric light plant.

SALT LAKE CITY, UTAH.—Engineer Hayward, of the Utah Light & Power Company of Salt Lake City, has been examining the waters of the Big Cottonwood canyon for the Great Western Mining Company, with a view to erecting a large power plant to furnish the Big Cottonwood mines with power. It is understood the plant will be built early next spring.

NORFOLK, VA.—The People's Light and Power Company of Norfolk has been granted a charter with a capital of $100,000.

RICHMOND, VA.—The Electrical Construction Company of Richmond, Va., has the contract for a $20,000 electric plant at Warrenton, Va.

FAIRMONT, W. VA.—A deal has been closed by the Fairmont Gas and Electric Company with the Fairmont and Grafton Gas Company, an old corporation, whereby the former becomes the owner of all the rights of the latter company in Fairmont.

EVANSTON, WYO.—The Edison Electric Company has been formed here. Directors: H. Fisher, J. B. Miller, H. H. Sinclare, F. B. Hinge and others. Capital stock, $10,000,000.

MONTREAL, QUE.—The Shawinigan Water & Power Company has made a proposition to the Dominion government for lighting the channel from Montreal to Quebec.

OTTAWA, ONT.—The town plant of Fort William, Ont., has been found insufficient to provide the necessary light and power. A proposition is now under consideration to develop the Ecarte Rapids power. Messrs T. Pringle & Sons, of Montreal, estimate the cost of developing 2,000 horse-hower there at $207,000.

OTTAWA, ONT.—The Ontario government has authorized the construction of a coffer-dam at Dufferin Islands, on the Niagara river, by the Ontario Power Company, to be used in diverting water through the park to the company's outlet below the falls. Although the company's application has been opposed by the Canadian Niagara Power Company, which was first in the field, the government has decided to grant the Ontario Power Company's application, in order to stimulate competition in that district.

THE ELECTRIC RAILWAY.

HARRISON, ARK.—Toledo capitalists have entered into a project for connecting Harrison with Dodd City, by an electric railway. John J. Greghan, of Toledo, may be addressed.

HARTFORD, CONN.—The Hartford Street Railway Company is engaged in making an addition to its power equipment at the power house on Commerce Street, and is now installing a 1500-hp engine. The engine is from the Westinghouse, Church, Kerr & Co. works of Pittsburg, and is connected to a Westinghouse generator of 1050-kw. When the engine is installed the company will have a capacity of 5000-hp.

WARSAW, IND.—The directors of the Winona assembly have voted to construct an electric railway between this city and Winona.

INDIANAPOLIS, IND.—A trolley line from this city to Springfield, Ill., by way of Terre Haute and Paris, Ill., is projected. A. J. Hunter, of Paris, is chief promoter.

FRANKLIN, IND.—President Irwin announces that the contract has been let for the extension of the Indianapolis, Greenwood and Franklin electric line to Columbus, a distance of 20 miles.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company has interests at work with a view to organizing a company to construct an interurban line between Indianapolis and Cincinnati.

ELKHART, IND.—The Elkhart, South Bend & Chicago Railway Company, which proposes to connect Elkhart, South Bend and Mishawaka with an electric road, has been incorporated. Capital stock, $15,000.

KOKOMO, IND.—The Kokomo Street Railway and Traction Company has been reorganized and is now the Kokomo Railway & Light Company. Capital, $80,000. G. J. Marott, president. Extensions are projected.

NEW ALBANY, IND.—Interest has been revived in the contemplated electric road from Cincinnati to Louisville along the Indiana shore of the Ohio river. Colonel A. S. Berry and Engineer Lyman are looking after the two surveys now being made.

INDIANAPOLIS, IND.—The Richmond and Ohio Traction Company of Richmond has incorporated with $10,000 capital. The company will build an electric line from College Corner, through Liberty to Richmond and from Richmond to Connersville, aggregating 35 miles.

BUTTE, NEB.—Butte, Neb., has subscribed $40,000 for a new electric railway to connect the town with the new Elkhorn extension at Anoka.

ALBANY, N. Y.—The Mineola, Hempstead and Freeport Traction Company has changed its corporate name to the Long Island Traction Company.

OYSTER BAY, N.. Y.—It is now certain that a trolley line is to be built from this village through the chain of villages between here and Mineola, at which point it will connect with the existing cross island line.

NEW YORK, N. Y.—At a special meeting of the stockholders of the Interborough Rapid Transit Company it was voted to increase the capital stock of the company from $25,000,000 to $35,000,000. The purpose of the increase is to raise funds to defray the expense of building the projected tunnel from Manhattan to Brooklyn, connecting with the Manhattan underground system.

YOUNGSTOWN, OHIO.—The Sharon & New Castle Railway is now running cars regularly from Hubbard to New Castle.

JAMESTOWN, OHIO.—The Springfield & Washington Traction Company has selected a site for a power station in this place.

COLUMBUS, OHIO.—The Delaware, Berkshire and Sunbury Electric Railway Company has increased its capital from $10,000 to $150,000.

CINCINNATI, OHIO.—The Bullock Electric Manufacturing Company has just shipped a large generator to the Wheeling (W. Va.) Traction Company.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company will spend about $100,000 in improvements on the Cleveland & Eastern Division during the coming season.

LIMA, OHIO.—The Western Ohio Railway has commenced condemnation proceedings against a number of land owners to complete its right of way between Lima and Findlay.

CONNEAUT, OHIO.—J. H. McWirt, representing the bondholders of the Conneaut & Eastern Railway, has applied to the county commissioners for a franchise from Conneaut to the Pennsylvania State line.

PORTSMOUTH, OHIO.—The charter of the Portsmouth Street Railway will be changed to enable the company to build to Hanging Rock, where connection will be made with the lines of the Camden Interstate Railway.

CLEVELAND, OHIO.—The Osborn Engineering Company has completed the surveys for the Mansfield, Mt. Gilead & Defiance Railway. The power station will be at Cardington or Mt. Gilead and there will be three substations.

TOLEDO, OHIO.—The promoters of the Toledo & Bryan Air Line Railway assert that eastern capitalists have agreed to finance the project and that it will be bonded for $18,000 per mile; construction work to start this fall. The road is projected from Toledo to Ft. Wayne.

PROSPECT, OHIO.—The promoters of the Magnetic Springs, Green Camp & Prospect Railway, owning franchises and rights of way between the towns named, also a site for a park and power house, are prepared to turn over the rights and plans to a company which will guarantee the building of the road.

DAYTON, OHIO.—The Dayton, Springfield & Urbana Railway Company's power house at Medway is being enlarged to nearly three times its present capacity and when completed it will furnish power for nearly all of the Appleyard-syndicate system between Cincinnati and Columbus. The plant will be in operation in about three months.

STEUBENVILLE, OHIO.—Work has been started at Brilliant on the new power house of the Steubenville, Mingo & Ohio Valley Traction Company. The station will also furnish power for the Wheeling-Wellsburg Railway on the West Virginia side of the Ohio River and a submarine cable will be laid for the feed wires. The station will cost about $175,000.

CINCINNATI, OHIO.—The Cincinnati Traction Company is planning to introduce a parcel-delivery system with ten delivery stations in various portions of the city. The company will act only as carrier, the present delivery companies doing the collecting. Stamps will be sold, which, when pasted on a parcel, insures delivery to the proper distributing station.

BARBERTON, OHIO.—The Northern Ohio Traction Company has secured a lighting franchise in Barberton, and has closed a contract to furnish light to the town. The rate will be $75 per lamp per year on moonlight schedule. The rate for commercial lighting will be 10 and 12 cents per kw-hour. The council will buy 45 new arc lamps and other material.

SANDUSKY, OHIO.—A prospectus of the Sandusky, Clyde, Tiffin & Southern Railway shows that the road will be 37.16 miles long, touching Sandusky, Castalia, York, Clyde, Green Springs and Tiffin, drawing from a tributary population of 50,000. Bonds to the amount of $650,000 are to be issued. The officers are J. C. Parker, president; J. C. Hauser, secretary; F. P. Zollinger, treasurer. Others interested are Ira Comstock, W. W. Woodward, G. R. Butler and W. H. Johnson.

DILLSBURG, PA.—A charter has been issued by the State department to the Dillsburg and Allen Electric Street Railway Company to build a line from Dillsburg to Churchtown, a distance of six miles; capital, $50,000; president, Peter Sidle, Dillsburg.

PITTSBURG, PA.—The efficiency of the street railway service in the eastern portion of the city is to be still further increased by the Pittsburg Railways Company by the rejuvenation of the old Broad Street power station of the Allegheny County Light Company. Several street railway generators and a large number of storage batteries are to be installed there for the purpose of furnishing more power.

MARTINSBURG, W. VA.—The Charles Town, Berryville and Winchester Street Railway Company, of Charles Town, W. Va., has been incorporated for the purpose of constructing and operating a street railway in West Virginia and Maryland. Capital $500,000. The incorporators are S. M. Patterson, New York; George Eyster, F. S. Harrison, of Halltown, Va.; R. P. Chew and W. O. Morris, of Charles Town, W. Va.

THE AUTOMOBILE.

THE INTERURBAN MOTOR COMPANY has been incorporated at Auburn, Ind., with a capital of $5,000. It has already started regular trips with new automobiles between Auburn, Garrett and Waterloo. The company proposes to take the place of the long-talked-of electric railway between these points.

RECORD DISTANCE ON ONE CHARGE.—A. C. Newly, of Indianapolis, Ind., claims to hold the record for distance covered by an electric automobile on one charge of the battery. Mr. Newly completed in the streets of Indianapolis in the night time a run of 118 miles on one charge, in an Indianapolis machine.

THE PORTLAND TRANSIT COMPANY has been organized at Portland, Ind., with a capital of $10,000, to run a line of automobiles between Portland and Camden, there connecting with the Dunkirk and Redkey automobile line. Eiler & Boyd, of Portland, have been selected to purchase the automobiles. They are open to correspondence from automobile firms.

THE LONG ISLAND HIGHWAY PROTECTIVE SOCIETY has filed its certificate of incorporation. The objects of the society are the protection of the interests and the rights of the people in the highways of Long Island, the cooperation with the authorities for the enforcement of laws governing motor vehicles, and of other riding and driving equipages and the general care of the highways on Long Island. The principal offices of the society are to be at Oyster Bay, Nassau County, and the directors for the first year are R. W. Gibson, Thomas S. Young, W. Emlen Roosevelt, William J. Young, Arthur D. Weeks, and C. W. Nelmore, of Oyster Bay; William F. Sheehan and George R. Sheldon, of New York City; William H. Baldwin, Jr., of Locust Valley, and William J. Matheson, of Cold Spring Harbor.

LEGAL.

DISCRIMINATION IN LIGHTING.—Because R. Snell did not have his residence wired for light by the Clinton (Ill.) Electric Light, Heat and Power Company, that corporation refused, when Snell applied to it for electric lighting, to install a transformer in his house without cost, although its practice was to furnish customers with such transformer free. The Supreme Court of Illinois has sustained Mr. Snell's appeal from the decision of a lower court refusing to grant him a mandamus against the company. The Court holds that the discrimination was an unjust one. The electric light company's contention was that it only considered itself under obligation to furnish the transformer free where it had been allowed to make a profit in wiring a house. Justice Carter, in giving the opinion of the Court, after stating that a transformer or reducer is just as necessary in lighting houses as the pole on which it is fastened or the wire that carries the electricity, says: "It is entirely immaterial who does the wiring of the house—the electric light company or some other party; the transformer is necessary in either case. If the company does the wiring, that is a business distinct from that of furnishing electricity for lighting purposes, just as the putting in of gas and water pipes into a house is a distinct business from furnishing the gas or water to flow through them. Appellee, being organized to do a business affected with a public interest, must treat all customers fairly and without unjust discrimination.

NEW INDUSTRIAL COMPANIES.

ELECTRO METALLIC ARCH COMPANY has been formed at Philadelphia, with a capital of $30,000, to carry on the business of electroplating.

CHICAGO TELEPHONE SUPPLY COMPANY, Augusta, to make and deal in telephone supplies of all kinds; capital, $500,000. President, F. L. Dutton; treasurer, W. L. Beedle, both of Augusta.

E. B. LATHAM & COMPANY, New York, have been incorporated to deal in machinery and electrical supplies; capital, $100,000. Directors: Ernest B. Latham, Charles A. Latham, John Lewis Owen, Brooklyn.

C. E. HEWITT & COMPANY, New York, have been incorporated to deal in electrical supplies and do construction work; capital, $10,000. Directors: Charles E. Hewitt, Newburg; Ernest B. Latham, Henri Pressprich, Brooklyn.

AMERICAN INSTRUMENT COMPANY, of New York, has been formed, with a capital of $10,000, to make electrical and other apparatus. The directors are J. M. Boyle, N. T. Weitzel, both of New York, and G. T. Weitzel, of St. Louis.

THE MANHATTAN SMELTING AND REFINING COMPANY has been incorporated at Trenton, with a capital stock of $200,000, to produce metals and alloys by means of oxyhydrogen or electrical heat. The incorporators are Thomas S. Haight, Harry Brian Pearson and Edwin V. Machette, all of New York.

PERSONAL.

MR. T. A. EDISON denies the reports that he will enter his storage battery in the endurance run, New York to Boston, of the Automobile Club of America.

DR. F. A. C. PERRINE'S interesting paper on success in long distance power transmission, read before the Boston Society of Arts, has just been issued in pamphlet form.

MR. FRANK WRIGHT, the chief electrical engineering expert attached to the Monterey Steel Works now under construction in that Mexican city, is expected in New York early next week.

MR. FRANK V. BURTON, formerly with the Western Electric Company, and Sanderson & Porter, New York City, is now with the Bryant Electric and Perkins Electric Switch Companies of Bridgeport, Conn.

MR. MAX HUELSENBECK, chief engineer of the Helios Electrical Company of Ehrenfeld, Cologne, Germany, is now on a visit to this country and is making a trip of inspection of its chief electrical plants and factories.

MR. L. A. FERGUSON, chief engineer of the New York Edison Company and president of the National Light and Edison Illuminating Associations, has been spending a week or two down East preparatory to the Edison convention in the White Mountains.

MR. M. A. HAYS, agent for the land and industrial department of the Southern Railway, has become secretary of the Chamber of Commerce of Sault Ste Marie, Mich., and is devoting his energies to the development of its hydroelectric resources, on which so much capital has been expended.

MR. A. B. PAINE has an interesting illustrated article in the September *World's Work*, detailing his experiences in making a trolley trip from New York City to Chicago. That is to say, a large part of it was made by trolley; and in a year or two he thinks the other links will be filled in.

MR. W. F. ZIMMERMAN, formerly of the Westinghouse Company, but for some years past prominent in the management of the St. Lawrence Power Company, of Massena, has resigned from that enterprise, and before taking up any other work will indulge in a long rest, the first in six years.

MESSRS. EDWARD NOYES and W. G. T. Goodman, of Noyes Brothers, of Sydney and Melbourne, sailed for England on the Lucania, August 30. Their visit to this country was made largely for the purpose of placing contracts for apparatus for the electric tramway system, for which they have been appointed the engineers.

MR. W. R. WRIGHT, the English electrical engineering expert, who has recently been retained by the municipality of Wellington, New Zealand, in connection with the proposed electric traction system to be constructed in that antipodean city, is expected to arrive in the United States very shortly for the purpose of studying American electric traction methods.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company of New York, receives from *Harper's Weekly* the deserved compliment of having his portrait printed on its front page as one of the leading "Americans of to-morrow," in the series of that name. But what an atrocious portrait it is! A "dying duck in a thunderstorm" never looked worse.

DR. M. I. PUPIN, of Columbia University, New York, has just returned from a trip abroad. He says that he believes that the Marconi Company will win the suits instituted by that company against other wireless telegraph companies, alleging infringements of the Marconi patents. He bases his opinion on the fact that the other companies are obliged to use Marconi's invention of two upright wires to receive and forward messages.

GRAND DUKE BORIS, of Russia, cousin of the Czar, has been in New York during the past week and when interviewed spoke specially of electricity in America. "It's nothing but electricity here, there, and everywhere. Your street cars move because of electricity, and you even illuminate your stores and places of amusement with letters made of many electric globes. Americans are coming to us with their many electrical appliances for transportation and manufacture. They are welcome."

MR. THOMAS B. WHITTED, manager of the sales department of the General Electric Company's Denver office, has resigned to assume the technical management of the J. J. Henry enterprises, which include gas, electrical and power plants in a dozen western cities. Mr. Whitted began his career in the Schenectady shops, became engineer of the Denver office three years ago, and a year later was promoted to the position he now gives up. He has won a wide circle of friends and acquaintances in the Far West.

SWARTLEY-ERNST.—A great many electrical people will be interested to learn of the wedding in Philadelphia last week of Miss Charlotte Ernst, niece of Mr. Luther Stieringer, to Mr. H. C. Swartley, of Philadelphia. The happy pair are spending their honeymoon in the mountains of Maryland. Miss Ernst has for some years past been in the habit of attending electrical conventions with her uncle, and has made a host of warm friends and admirers, some of whom had indeed counted upon her participation in meetings now about to take place.

MR. EMILIO DYSTERUD, chief engineer of the Monterey Electric Light & Power Company of Monterey, Mexico, is now in the United States. He will remain for some three weeks and inspect the various electrical plants, and it is anticipated that he will make arrangements with a view to the placing of considerable contracts for equipment, etc., to be installed in a proposed addition to the existing plant. Mr. Dysterud is making his headquarters at the office of the Federal Electric Company, Washington Building, 141 Broadway. Broadway.

MR. CHARLES J. GLIDDEN, of Lowell, Mass., and Mr. Dudley E. Waters, president of the Grand Rapids National Bank, of Grand Rapids, Mich., who, with Mrs. Glidden and Mrs. Waters, are making a four thousand mile drive on Mr. Glidden's 16-hp Napier automobile, have arrived at Lucerne, at last reports. They have covered 2,066 miles of their trip. They have traversed the Albula, Brenner, Aprica and St. Gothard passes, the latter in a snowstorm. Mr. Gidden relates that the temperature there was so low that it froze the gasolene, so that it was necessary to come down to Andermatt without power.

MR. C. L. BUCKINGHAM, the well-known New York patent attorney who has for many years past had offices in the Western Union Building, has just secured larger and finer quarters in the Potter Building, in a suite looking out upon the City Hall Park. In addition to practice for the Western Union, General Electric and other large corporations, Mr. Buckingham has of late found time to develop and perfect the highly practical telegraph system bearing his name, in which, it will be remembered, using an ingenious alphabet system for mechanical transmission, the message is received and printed an a regular blank ready for delivery.

MR. FRANK JONES is reported from Hartford, Conn., to have returned from South America a millionaire and to have already negotiated the purchase of Bear Top Mountain as a summer home. Seeking fortune, he has traveled well over the world, and to-day, it is stated, he occupies a place as the financial leader of South America. He is president of the East Coast Telephone Company, which controls practically all of the telephone lines of South America. He has offices in Buenos Ayres and London, and he is about to open offices in New York. After considerable wandering about the world he brought up in Argentina. Being much interested in electricity he found employment with one of the telephone companies that was just starting. His ability and energy were quickly recognized, and it was not long before he was in a position to force his fortunes. He brought about the amalgamation of all of the telephone lines along the east coast of South America, and he is now practically the owner of the entire system.

MR. JAMES HOULEHAN, of Toledo, O., has found out how to turn the energy of a permanent magnet into the production of continuous or rotary motion—indeed, has patented "a form of permanent magnet in which there is no zero point or dead centre." He says: "A horseshoe-shaped piece of steel can be magnetized in a few seconds by an electric current of a few amperes from a battery or a dynamo. And the amount of electrical energy used is ridiculously small, but the magnet so made can lift many pounds of iron in contact or a less without contact; and, stranger still, the exercise of this power strengthens the magnet. This mystery of the magnet has never been solved. All that I claim is that I have discovered a method whereby its 'pull' on a piece of iron can be made to produce rotary motion. By this means it is possible to use the magnet's force in the driving of machinery or other application of power. It is not a storage or reacting device like a steel spring which, when it is wound up, gives back approximately the force required in winding, but no more. The magnet resembles a spring that when you wind it keeps wound up, giving out its force indefinitely."

OBITUARY.

MR. LEVI SPRAGUE, formerly president of the Erie Telephone and Telegraph Company, died at his home in Lowell, Mass., last week from heart disease. He was ninety-two years old.

MR. E. P. WHITFORD, one of the oldest telegraph operators in the country, died last week of heart failure in the Onwentsia Clubhouse at Lake Forest, Ill., where he was in charge of Postal Telegraph Company operators during the Western Women's Golf Championship Tournament.

Trade Notes.

THE PHOENIX GLASS COMPANY, New York, has just issued a neat little catalogue illustrating its various styles of shades, globes, etc.

SEEING STARS.—Both astronomers and amateur photographers are appealed to strongly in the article on "Celestial Photography" which *The Living Age* for August 23 reprints from *Blackwood's*.

THE BURT MFG. CO., of Akron, Ohio, has just received an order from the United States government for two of its Cross oil filters for one of the new torpedo boats, and also two filters for the Navy Yard at Bremerton, Wash.

TELEPHONE SUPPLIES.—The Vallee Bros. Electrical Company, 625 Arch Street, Philadelphia, Pa., in its catalogue No. 13 gives illustrations and price-lists of its full line of telephone and telegraph supplies, including fuses, lightning arresters, etc.

EL-BEND.—Mr. William W. Benson, inventor of the El-Bend, is a frequent visitor to New York. The El-Bend has attracted a great deal of attention, and orders have reached the firm manufacturing them in large quantities since the device has been put on the market.

MR. JAMES G. BIDDLE, 1023 Stephen Girard Building, Philadelphia, Pa., dealer in electrical instruments, reports that August has been a record-breaker. His sales for that month have been greater than in any previous month since he has been in business. While Mr. Biddle can furnish promptly any instrument that is made, he represents directly Morris E. Leeds & Co., Western Electrical Instrument Co., The Bristol Co., Kelvin & Jas. White, Ltd., and Société Generoise.

M. & O. COMPANY.—H. W. Morris, formerly engineer of the Gibbs Electric Company and recently secretary and engineer of the Milwaukee Electric Company, has associated himself with John Ohenberger, formerly general foreman of the Gibbs Electric Company, and recently superintendent of J. & J. Obenberger, under the name of the M. & O. Company. The firm will locate in Milwaukee, and, having acquired the machine shop of J. & J. Obenberger, will manufacture a line of dynamos and motors.

THE GORDON BATTERY COMPANY, 439 East 144th Street, New York, is having an excellent trade in its Gordon cell, particularly among telephone and gas engine manufacturers. It is pointed out that several prominent railway companies use Gordon cells exclusively in the operation of their signals. The company has a plant of large capacity and is in a position to promptly fill orders of any magnitude for immediate shipment. The company describes and illustrates its cell in a booklet, a copy of which it will be glad to send to anyone on request.

CORDS FOR ARC LAMPS.—Many managers of central stations have not given attention enough to the danger from broken arc lamps by falling. If a smooth, firmly-braided cord is used, the chances of loss of the lamp or loss of life from its falling are a minimum. There is much ordinary cheap sash cord purchased for this purpose and called "just as good." It is quite a different article from the best solid braided cord. The Samson Cordage Works, Boston, state that their trade mark, the colored "Spot," is used only on their extra quality cord. The "Samson Spot Cord," assures the buyer, they say, that he is getting the best thing that is made for the purpose.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has been unusually successful with its Browning small motors and generators for which it is general sales agent. It states that this type of motor and dynamo, made in sizes of 1/40 to 10-hp and 1/8 to 8½-kw, has met with instantaneous success. The workmanship and material in these machines is the very best, and they are sold under the strongest guarantee. This apparatus is especially designed to be used where a high grade, strong and compact motor is necessary, and is adapted for all small power works, manufacturers, jewelers, hotels, clubs, restaurants, or small lighting plants. The company issues a very complete bulletin covering this apparatus, a copy of which will be mailed upon application.

THE CUTTER COMPANY, of Philadelphia, the well-known manufacturer of I-T-E circuit breakers and the selling agents of Keystone measuring instruments, has just brought out a handsome volume which undoubtedly will prove of value not alone to the consulting engineer, but to the contractor, switchboard builder and the engineer in charge of the large isolated plant. "I-T-E Switchboard Practice," is a volume of 243 pages, printed on the finest plate paper 9x11 and handsomely bound in cloth with colored edges. It is a supplement to "Modern Switchboards," which was published several years ago, and it brings that work, which has for some time been out of print, right down to date. As is quite natural, the subject of circuit breakers is treated with care and exactness, the Cutter Company, whose work in this line is so well known, having devoted several chapters to this important subject. Indeed, the question of circuit breakers appears to be one on which the last word is never said and a chapter on "Switchboards without Switches" appears suggestive. Other chapters are devoted to the question of the selection, use and care of measuring instruments. The scope of the work may be suggested by the following chapter headings: "Switchboard for Manufacturing Plant." "Switchboard for Street Railway Company." "Special Types of Circuit Breakers and Their Accessories." "Circuit Breakers and Their Use in Power Transmission." Model specifications which will be of service to many are also given and the whole volume is very fully illustrated with drawings, half-tones and diagrams. The price is $3.00, express paid.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 26, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

707,557. TELEGRAPHIC APPARATUS; C. M. Davis, Chicago, Ill. App. filed July 27, 1901. To make the working of the line as good when leakage is taking place as at other times, the line circuit is momentarily disconnected from the main battery directly after the opening of a transmitting key, thereby withdrawing all current from the line and causing the relay magnets to become deenergized and their levers to be retracted.

707,562. ELECTROTHERAPEUTIC BATTERY; T. J. Dunn, Jersey City, N. J. App. filed Jan. 3, 1902. The two handles or electrodes are used to cover the ends of the battery casing when the apparatus is not in use.

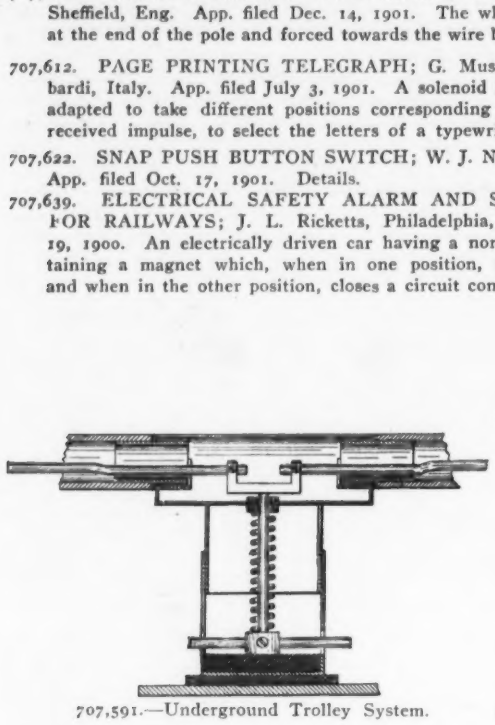
707,591. UNDERGROUND TROLLEY SYSTEM; F. A. Howarth, Johnstown, N. Y. App. filed Nov. 22, 1901. The main conductor is inclosed in a sectional flexible conduit and normally out of contact therewith. The pressure of the trolley against the conduit distorts and carries it against the conductor to establish the circuit.

707,606. TROLLEY FOR USE IN ELECTRIC TRACTION; J. G. Lister, Sheffield, Eng. App. filed Dec. 14, 1901. The wheel is pivotally mounted at the end of the pole and forced towards the wire by an independent spring.

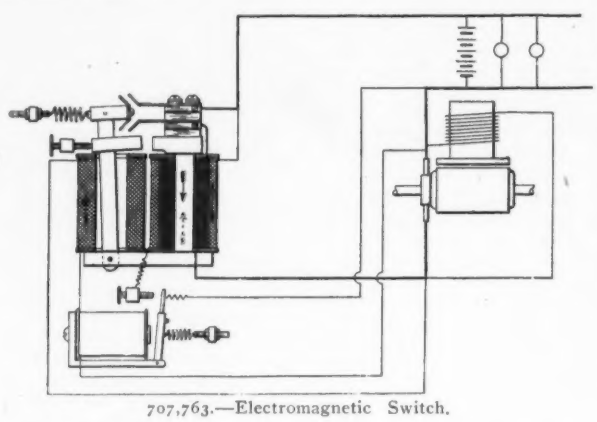
707,612. PAGE PRINTING TELEGRAPH; G. Musso, S. Angelo Dei Lombardi, Italy. App. filed July 3, 1901. A solenoid is rotatably mounted and adapted to take different positions corresponding to the intensity of the received impulse, to select the letters of a typewriting machine.

707,622. SNAP PUSH BUTTON SWITCH; W. J. Newton, New York, N. Y. App. filed Oct. 17, 1901. Details.

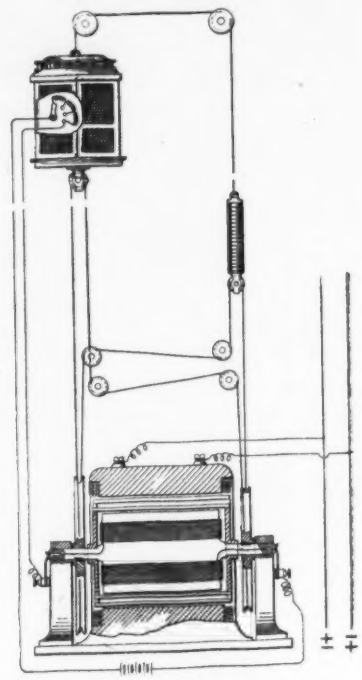
707,639. ELECTRICAL SAFETY ALARM AND SIGNAL MECHANISM FOR RAILWAYS; J. L. Ricketts, Philadelphia, Pa. App. filed March 19, 1900. An electrically driven car having a normally closed circuit containing a magnet which, when in one position, closes the motor circuit and when in the other position, closes a circuit containing a signal lamp on the car, a track circuit adapted to be connected in series with the car circuit whereby, when said track circuit is open, the motor will be stopped and the signal lamp lighted.



707,591.—Underground Trolley System.



707,763.—Electromagnetic Switch.



707 839.—Elevator.

707,663. RAIL BOND; M. F. Whiton, Hingham, Mass. App. filed Feb. 3, 1902. A laminated bond in which the ends or feet are held together by solder and a rivet.

707,666. ELECTRODE FOR STORAGE BATTERIES; H. Woodward, London, Eng. App. filed Jan. 15, 1901. An accumulator plate comprising a number of strips crossing each other and pivotally connected together to permit expansion and contraction.

707,699. CHARGING SWITCH; M. R. Hutchison, New York, N. Y. App. filed Nov. 15, 1901. A charging switch for the use of unskilled persons embodying a polarized armature and a switch and indicator controlled thereby. When the polarity of the current is correct for charging, the indicator shows the fact, as well as the reverse.

707,731. ELECTRIC BATTERY; E. A. G. Street, Paris, France. App. filed April 22, 1902. The depolarizing material is placed in a receptacle which is removably connected with the electrode with which it cooperates.

707,754. BRUSH MECHANISM FOR DYNAMOS; W. L. Bliss, Brooklyn, N. Y. App. filed Feb. 3, 1902. The brush holder is mounted to turn by the frictional engagement of the commutator and brushes, when the machine is reversed, stops being arranged to hold the brushes in each working position.

707,761. CIRCUIT CLOSING DEVICE; A. B. Chance, Centralia, Mo. App. filed July 25, 1901. (See page 382.)

707,763. ELECTROMAGNETIC SWITCH; J. L. Creveling, New York, N. Y. App. filed Nov. 18, 1901. An electromagnetic switch apparatus for car lighting purposes adapted to cut the battery in and out of the generator circuit automatically by changes in voltage.

707,776. OSCILLATING ELECTRIC FURNACE; P. L. T. Héroult, La Praz, France. App. filed Aug. 21, 1901. (See page 381.)

707,797. ROTARY APPARATUS FOR THE PRODUCTION OF DIFFUSED ELECTRIC DISCHARGES; M. Oto, Neuilly, France. App. filed Nov. 12, 1901. (See page 381.)

707,804. ELECTROLYTIC CELL; A. Sommer, Cambridge, Mass. App. filed Aug. 17, 1899.

707,829. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. A system of superposed current telegraphy for way station work, in which the impedance of any inductance or condenser employed on either side of the system is removed from circuit when the key is not in use.

707,830. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. Details relating to superposed current telegraphy, designed to increase the limit of the pulsatory current and make possible the use of smaller condensers.

707,835. MEANS FOR GENERATING COUNTER ELECTROMOTIVE FORCE; H. H. Dow, Midland, Mich. App. filed April 21, 1900. The polarizing capacity of the cell is increased by using granular material upon the surfaces of the electrode, such material being of the same kind as the electrode itself.

707,839. ELEVATOR; E. R. Gill, New York, N. Y. App. filed Dec. 16, 1899. An apparatus by which synchronous alternating current motors can be used to operate elevators.

707,842. ELECTRIC FAN; G. C. Hawkins, Boston, and H. L. Flint, Cambridge, Mass. App. filed March 29, 1901. The standard supporting the fan is extensible and the conductors arranged therein slide through contact devices to permit of the adjustment of the standard without destroying the circuit.

707,843. ELECTRIC SWITCH OR CUT OUT; J. A. Heany, Philadelphia, Pa. App. filed Dec. 11, 1901. Details.

707,844. ELECTRIC RAILWAY SYSTEM; J. C. Henry, Denver, Colo. App. filed April 9, 1901. The positive and negative conductors are protected by the flanges of an I-beam arranged between the rails, the conductors being set in an insulating cement filled into the space between said flanges.

707,886. PROCESS OF MANUFACTURING MANURE FROM APATITE OR SIMILAR MINERAL PHOSPHATE; J. G. Wiborgh and W. Palmaer, Stockholm, Sweden. App. filed Oct. 22, 1900. (See page 381.)

707,894. AUTOMATIC CUT OUT; G. E. Andrews, Providence, R. I. App. filed Nov. 1, 1901. A spring cut out switch released by the destruction of a fuse.

707,952. CIRCUIT BREAKER; F. Benziger, Union Hill, N. J. App. filed Jan. 29, 1902. An improvement in the latch for the switch lever described in patent No. 686,918.

707,959. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. Details relating to superposed current telegraphy. Designed to avoid any disturbance in the receiving instrument due to the discharge of condensers or to the operation of any of the keys or transmitters in the system.

707,967. AUTOMATIC SWITCH FOR ELECTRIC PUMPS; A. C. Griscom, New York, N. Y. App. filed Nov. 12, 1901. The core of the solenoid enters spring contact jaws at each end of its stroke and an auxiliary core having a limited initial movement along the main core, imparts a driving movement to the latter to release it from the contact jaws.

707,975 and 707,976. MERCURY-VAPOR LAMP; H. N. Potter, Pittsburg, Pa. Apps. filed July 24 and Dec. 31, 1900. (See Current News and Notes.)